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MONTHLY NOTICES

OF THE

ROYAL ASTRONOMICAL SOCIETY.

VOL. LX. NO. 4. JANUARY 1900 (*continued*).

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ROYAL ASTRONOMICAL SOCIETY.

VOL. LX. JANUARY 12, 1900—(*continued*). NO. 4

On the Probable Motion of the Annular Nebula in Lyra (M 57) and the peculiarities in the Focus for the Planetary Nebulæ and their Nuclei. By E. E. Barnard.

In *Ast. Nach.* 2186, Bd. 92, Professor Hall has given measures of some of the small stars near the annular nebula of *Lyra* (M 57), made with the 26-inch at Washington in 1877 July and August.

I have taken the means of his various measures which are here given. For reference he has used the 12-magnitude star close following the nebula except for the stars f_1 and f_2.

	°	″	
a and *b*	225·5	93·90 (2*n*)	Mag. 14
a „ *c*	268·0	115·83 (2*n*)	„ 13·14
a „ *d*	286·9	138·58 (2*n*)	„ 12·13
a „ *e*	292·6	122·90 (2*n*)	„ 12
a „ *f*	313·7	101·79 (2*n*)	„ 13·14
a „ *g*	350·5	77·18 (2*n*)	„ 13
f „ f_1	253·3	3·96 (2*n*)	„ 13·14
f „ f_2	364·8	17·31 (2*n*)	„ 14·15

The different nights' measures, in the main, are very consistent except in the case of *f* and f_2, where the distances differ by one second.

Professor Hall was unable to see any star nearer the nebula than these, and could see no star anywhere within the nebula.

In 1891 Mr. Burnham measured the central star or nucleus with reference to the star *a* with the 36-inch. His measures are very consistent. and are undoubtedly the best that could be made of such an object. He mentions the fact that "all the measures were made under very favourable conditions, and the central star well seen."

On account of their importance I will give his measures in full (they are from *Pub. Lick Obs.*, vol. ii. 1894). The measures refer the star to the nucleus.

	°	″	m	m
1891·326	88·2	61·64	15·5	12·0
·416	87·8	61·44	15·5	13·5
·419	86·5	61·56	15·5	12·0
·518	88·4	62·28	15·0	13·0
·559	88·0	61·56	15·5	11·5
1891·45	87·8	61·69	15·4	12·4

These are the only measures of the nucleus that I know of. It is to be regretted that the admirable example shown by Mr. Burnham in measuring objects of this class is not more fully followed out when the micrometer is available. A mere sketch —no matter how carefully it is made—of the relative position of the nucleus of this object and the surrounding stars has no value whatever for the vital points in question, such as motion, &c. For the first time, therefore, we have the position of the nucleus fixed definitely for reference in future observations.

There is one point lacking, however, and that is, should any relative change occur it could not readily be seen whether it belonged to the nucleus or to *a*, or to both.

The excellent and valuable measures made by Hall in 1877 of the position of *a* with reference to surrounding stars have definitely prepared for this question.

I have been re-measuring some of the planetary nebulæ measured by Mr. Burnham with the 36-inch. The measures have been in very close agreement with his, thus showing no certain motion in the interval of some eight years, except possibly in the present instance.

During 1898 and 1899 I measured the relative position of the nucleus of M 57 and the star *a* with the 40-inch.

When the seeing permits it, the nucleus, in the great telescope, is distinctly seen, and is subject to fairly accurate measurement.

As the question of possible motion of the nebula has come up in the measures, I have measured the position of the nucleus from three other stars, besides repeating the measures of *a*.

These measures have been made with the utmost care, and I believe will fairly represent the relative position of the nucleus at the present time.

The Nucleus of M 57 and the Star a.

1898. July 12	1898·531	88°·98	60″·96
Aug. 8	·605	88·75	60·63
9	·607	88·50	60·87
10	·610	88·74	60·73
29	·662	88·90	60·67
	1898·60	88·77	60·77

1899. June 16	1899·459	89°·12	60″·79
18	·464	88·90	60·70
24	·481	89·67	60·52
July 1	·500	88·74	60·88
2	·503	89·27	60·74
	1899·48	89·14	60·73

The Nucleus and the Star b.

1899. July 29	1899·577	185°·46	65″·15
31	·582	185·40	65·15
Aug. 1	·585	185·25	65·07
	1899·58	185·37	65·12

The Nucleus and the Star c.

1899. July 8	1899·519	268°·27	54″·91
10	·525	266·72	55·22
16	·541	267·78	54·85
	1899·53	267·59	54·99

The Nucleus and the Star e.

1899. June 24	1899·481	312°·55	71″·14
July 1	·500	312·08	70·91
2	·503	312·50	71·14
	1899·49	312·38	71·06

It will be seen that my measures of the nucleus and *a* differ from Mr. Burnham's by about 1° in angle and 1″ in distance. While this is a small quantity for two different observers and telescopes dealing with a difficult object of this kind, yet it is worthy of consideration when the power of the instruments is considered, and when the two observers are as consistent as they always are in measurements like these. I am therefore under the impression that this apparent relative change may be a real

one, and the question comes up whether it is due to change in the star *a* or in the nucleus.

To test the stability of *a* I have repeated Professor Hall's measures of 1877, and have added three other stars to the list which have not previously been measured.

Of these stars the following are my estimates of magnitude with the 40-inch :—

	m		m
a	12·2 (3)	f_1	13·9 (2)
b	13·8 (2)	f_2	14·5 (2)
c	14·0 (3)	*g*	13·7 (2)
d	13·5 (3)	*h*	12·8 (3)
e	13·2 (3)	*k*	15·7 (4)
f	13·7 (3)	*p*	16·5 (2)*

* The position in reference to the nebula makes it difficult to decide on the magnitude of this star *p*. It is perhaps as bright as the $15\frac{1}{2}$ magnitude.

Following are the measures :—

a and b.

1899.		°	″
July 1	1899·500	225·50	93·54
2	·503	226·02	93·88
8	·519	225·77	93·65
	1899·51	225·76	93·69

a and c.

1899.		°	″
June 26	1899·486	268·75	115·73
July 1	·500	268·81	115·59
8	·519	268·77	115·83
	1899·50	268·78	115·72

a and d.

1899.		°	″
June 24	1899·481	286·59	*″
26	·486	287·17	137·59
July 2	·503	287·12	137·77
8	·519	286·97	137·95
	1899·50	286·96	137·77

* Seeing too poor for distance.

a and e.

1899.		°	″
June 17	1899·462	292·91	122·27
24	·481	292·72	122·30
	1899·47	292·81	122·28

a and g.

1899.		°	″
June 17	1899·462	350·91	75·90*
18	·465	350·60	76·34*
July 10	·525	350·75	76·78
Aug. 6	·600	350·85	76·00
	1899·51	350·78	76·25

* Single distance; faint and difficult.

a and f (the following and brightest of two).

1899.		°	″
June 26	1899·486	315·47	100·07
July 8	·519	315·32	100·11
	1899·50	315·39	100·09

f and a Star close preceding $= f_1$.

1899.		°	″
July 8	1899·519	261·10	5·11
9	·522	264·70	4·97
10	·525	263·05	4·62
	1899·53	262·95	4·90

f and a Star north $= f_2$.

1899.		°	″
July 8	1899·519	2·93	17·88
10	·525	3·92	17·89
	1899·52	3·42	17·88

Following are the three additional stars not previously observed :—

a and h.

1899.		°	″
June 16	1899·459	148·25	70·70
17	·462	148·23	70·36*
24	·481	147·94	70·80
	1899·47	148·14	70·62

* Clock drifting badly.

a and h.

1899.		°	″
July 31	1899·582	195·70	85·56
Aug. 1	·585	195·85	83·57*
5	·596	196·30	84·91
	·599	195·63	85·31
	604	195·82	85·25
	1899·59	195·86	85·26

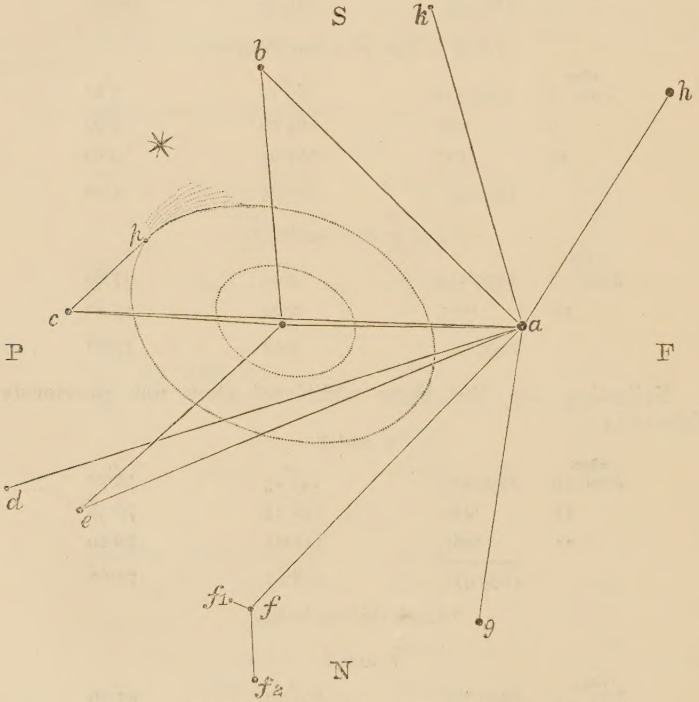
* Reject the distance.

c and p (in preceding edge of Nebula).

		°	″
1899. July 8	1899·519	133·30	27·08
10	·525	133·38	27·46
	1899·52	133·34	27·27

This star *p* is *exactly* on the north preceding edge of the nebula. The outline of the nebula would cut *exactly* through the star.

There is a 17th magnitude star—at the limit of vision for the 40-inch, and hence a good subject for photography—in 218° ± 60″ ± referred to the nucleus. This star was too faint to measure accurately, and I have taken its place from a sketch. On the diagram its place is marked with a ×.



Micrometrical Measures of M 57 and neighbouring stars.

The star *k* for some reason is very difficult to measure—more so than its magnitude would warrant. It has a dull appearance, and does not seem so well defined as stars of similar magnitude near. It looks as if it might be either a very small nebula or nebulous star.

In comparing these measures with Hall's made twenty-two

years ago there appears to be some change in some of the stars, but there is no very decided motion shown in the position of *a*.

The star *f* seems decidedly to be in motion when compared with f_1 and *a*. The position angle of f_1 has increased about 10°, and the distance about 1″, while the distance *a f* seems to have diminished over $1\frac{1}{2}$″.

If we reduce the two sets of measures of *a* and *f* to $\Delta\alpha$ and $\Delta\delta$, we get :—

Hall	$\Delta\alpha$	73″·59	$\Delta\delta$ 70″·32
Barnard		70·29	71·25
		3·30	0·93

The same for *f* and f_1 gives :—

Hall	3″·79	1″·14
Barnard	4·86	0·60
	1·07	0·54

while for *f* and f_2 the discordances are within the possible errors of measurement.

There seems to be possibly some motion in *d* also ; but it is uncertain. Some of the apparent change in *f* may be due to change in *a*, which might also account for the lessening of the distance *a d*. It seems to be difficult just now to definitely locate the motion, but it appears certain that motion is shown to exist in one or more of the stars.

The measures of *a* and *c*, however, show that the discrepancy in Mr. Burnham's measures of the nucleus and mine cannot be due to any motion in *a*, for it would also affect the distance *a c*, which does not seem to have sensibly changed in the past twenty-two years.

If the apparent motion shown by Mr. Burnham's measures and mine is real it next becomes a question whether the motion can be said to be in the nebula—that is, is the central star a real nucleus or an accidental projection? Everything points to its being a part of the nebula—that is, the nucleus. It is shown by photography to be highly actinic, though visually a very faint body, so that the relative photographic quality of its light is greater than that of other faint stars near.* It is almost certain, then, that if motion is found to exist in this central star it is a motion of the nebula itself.

I would suggest that the question of motion in this nebula is one singularly suited for the photographic plate to decide, because of the high actinic power of the nucleus. I should be very glad to see measures made of any existing photographs of this object, and I hope that the present paper will call attention to the

* I find that Dr. Scheiner (*Ast. Nach.* 3086), and Prof. Keeler (*Ast. Nach.* 3111), have shown that the central star M 57 must in reality be the nucleus of the nebula.

importance of securing accurate photographic data for the future investigation of the nebula and its surroundings.

The question of motion of the star *f* is an important one on account of its faintness.

So far as the visual work is concerned, the nucleus is now thoroughly tied up with the stars *a*, *b*, *c*, and *e*, and observations five or six years hence ought to show conclusively if the supposed motion is real. If there are any measurable photographs made six or eight years ago, they would be rather conclusive compared with others made now.

All the measures with the 40-inch have been reduced with a screw value of 9″·677. A final reduction of all the determinations running over some three years will slightly reduce this value, but not to materially affect the present measures.

In *A.N.* 3200 I have given an account (with sketch) of the discovery with the 36-inch, on 1893 October 2, of a rather conspicuous nebula, only 4′ from the centre of the ring nebula. I have measured this object with the 40-inch, in which it is decidedly conspicuous.

*Nucleus of M 57 and Nebula.**

1899 July 16	1899·541	303°·9	244″·47
17	·544	303°·8	244″·22
	1899·54	303°·8	244″·34

The measures in 1893 (two nights) gave :—

Nucleus and Nebula.

1893·76	302°·8	243″·68

During 1893 and 1894 I secured a series of measures of the dimensions of M 57 and the position angle of the major axis. These were published in *Ast. Nach.* 3354. I will here repeat the mean results of these measures for completeness in the present paper.

Position Angle of the Major Axis.

1893·95 ... ... 65°·43 (9 nights)

Outer Major Diameter.

1894·44 ... ... 80″·89 (5 nights)

Inner Major Diameter.

1893·87 ... ... 36″·52 (5 nights)

Outer Minor Diameter.

1894·12 ... ... 58″·81 (6 nights)

* In an article in the October *Astrophysical Journal* Professor Keeler says that his photographs of the annular nebula show this small nebula to be a left-handed spiral.

Inner Minor Diameter.

1893·87 ... ... 29″·36 (5 nights)

All the measures in this paper depend on double distances. From four to five settings for the position angles and three to four settings on each side of the fixed wire for the distances were made.

The nebula is a beautiful object in the great telescope; though the ring appears to be unequally bright in places, but little detail can be made out on it with certainty. There is a faint brushing out of the light from the south preceding edge of the ring. Under the best conditions the interior of the ring has appeared of unequal brightness. The light of the ring itself, however, blinds one's eye to the details on the interior, so that it is not possible to speak with certainty of the form of these details.

In *Comptes Rendus*, No. 5, for 1899 July 31 is a paper by MM. Bourget, Montangerand, and Baillaud calling attention to important changes which they find to have occurred in this nebula in the past ten years.

According to these observers the central star or nucleus has increased greatly in brightness of late years.

These gentlemen, observing the nucleus on 1899 July 8 with the great reflector of the Toulouse Observatory, of $0^m{\cdot}83$ (33 inches) aperture, found it an easy object. From this observation, and from photographs made in 1890 and 1899, they concluded great changes had taken place, both in the form of the nebula and in the brightness of the central star.

I have been familiar with this object for upwards of ten years, as it has appeared in the 36-inch at the Lick Observatory and in the 40-inch here. In 1893 and 1894 I made a special study of the nebula with the 36-inch, and measured all its dimensions on a number of nights, and specially noted the appearance of the central star.

So far as visual observations go, I am unable to verify the striking changes indicated by the Toulouse observations. Indeed, on the very night that those observations were made—1899 July 8—I measured the nucleus with the 40-inch, and saw nothing different from what I have seen for the past ten years. On that night I noted the nucleus as about $15\frac{1}{2}$ or 16^m from a direct estimate, and from comparison with a star outside the ring. Mr. Burnham's estimate in 1891 made it 15·4 magnitude.

The nucleus of this object is quite like that of the *Andromeda* nebula (M 31) in the uncertainty and deception in fixing any change that might occur in its brightness. The fact that the nucleus is seen on a nebulous background makes steadiness of the atmosphere a most important factor in its distinctness—far more so than in the case of an ordinary star in the open sky. When the seeing is exceptionally good, the nucleus appears with a distinctness strikingly in contrast with its ordinary condition,

so much so that one has to guard against deception in supposing a real change of light. So much do the atmospheric conditions enter into this question of change in the nucleus of a nebula that the frequent observations of variability in these objects might be properly translated into "fine seeing," "good seeing," "poor seeing," and "bad seeing" in the decreasing order of reported brightness of the object.

The observers at Toulouse also speak of their photographs having likewise proved that the central star had increased greatly in brightness. They do not say, however, that the nucleus is brighter than stars on the same plate which it had equalled in 1890. Such might be considered a test of actual change, though this in itself is also subject for criticism from the very causes mentioned above, though not to the same extent. The fact, however, that a photograph of to-day shows the star quicker than one nine or ten years ago, might be accounted for by an increase of sensitiveness of the plate alone.

Since writing the main portion of this paper I have seen some very fine photographs of M 57 taken by Professor Keeler with the 37-inch Crossley reflector of the Lick Observatory. These beautiful photographs show the very faint star I have mentioned as being essentially at the limit of the 40-inch, and also several stars that are apparently fainter on the photographs. The brushing out of the nebulosity from the south preceding edge of the ring is shown, and a similar appearance from the north following edge. These photographs also show a second star in the ring north preceding the central star. The star *p* is also shown. I have never been sure of seeing the second star in the ring, but have thought at times that I could see it faintly. This star is difficult visually, not only on account of actual faintness, but also from the fact that it is near the inner edge of the bright ring which blinds one to its feeble light. It was seen at the Lick Observatory, and described in a paper on the nebula by Professors Holden and Schaeberle in *M.N.* vol. xlviii. p. 383.

In a paper in the *Astrophysical Journal* for 1899 October Professor Keeler seems to infer that the star *p* is not a real star, but a condensation in the nebula. This seems hardly probable, for it is exactly on the extreme edge of the nebula visually, and I have been struck with its perfectly stellar appearance when measuring it, and have so recorded it. I think it must be but an ordinary star, and that its close proximity to the nebula is quite accidental.

In a drawing of M 57, made with the 4-foot reflector, issued in a circular dated "Bradstones, Sandfield Park, near Liverpool, 1860 November 19," Lassell shows the central star (not, however, exactly in its true position), and refers to it as being near the limit of vision of his telescope.

Peculiarities in the Focus for the Planetary Nebulæ.

It is a well-known fact that the planetary nebulæ come to a focus outside the focus for an ordinary star. This, of course, is due to peculiarities in their spectra.

In examining the different planetary nebulæ, I have made some experiments in this line with the 40-inch, which may be of general interest.

With a magnifying power of 1300 diameters in these observations, the nebula was brought to the best focus, and a scale of inches on the focussing tube read. This would be repeated for the nucleus and also for an ordinary star. The result so far has been tabulated, and the quantities given are fractions of an inch. A plus quantity means that the first object comes to a focus further from the object glass than for the second. It is probable, by this means, we may be able to determine the wave length of the light of the nuclei of these nebulæ, which are too faint to observe with the spectroscope.

This table is preliminary, and as the subject will be carried out for all the planetary nebulæ, a more complete and accurate table will be published later. It is of sufficient interest, however, to warrant its publication here in an incomplete form.

Table of Focus for the Planetary Nebulæ.

N.G.C.	α 1860·0. h m s	δ 1860·0· ° ′	Neb.—Nucl. in.	Neb.—Star. in.	Nucl.—Star. in.
1535	4 7 44	−13 6	+0·22	+0·27	+0·05
2392	7 20 53	+21 12	+0·26	+0·29	+0·03
6543	17 58 36	+66 38	+0·18	+0·23	+0·05
6720 (M 57)	18 48 23	+32 51	+0·20	+0·30	+0·10
6826	19 41 2	+50 11	+0·22	+0·21	−0·01
7009	20 56 33	−11 55	+0·19	+0·23	+0·04
7662	23 19 11	+41 45	+0·06	+0·20	+0·14
			+0·19	+0·25	+0·06

These are in each case the means of five or more settings for focus.

The focus for Hind's celebrated crimson star is 0·06 in. outside of that for a white star nearly of same magnitude.

It will be seen from this tabulation that the planetary nebulæ so far observed give a focus for the nebula itself—about 0·19 inch farther out than its nucleus and about 0·25 inch farther out than for a fixed star. It is seen also that the nucleus comes to a focus nearer the fixed star than for the nebula and a little farther out than for the star.

The average doubtless does not mean as much as might be supposed. There seem to be individual cases which markedly differ from the others. For instance, 2392 is conspicuously

distinct from the others in the large increase of focus for its nebulosity, while the central star focus closely agrees with the average difference of nucleus-star. No. 6826 seems abnormal in this last respect. The central star seems to come out about the same for its comparison star. The minus sign is doubtless accidental. There are no details in this nebula, so that the focus for the nebula itself is rather difficult, though the settings are accordant.

No. 2392 is one of the most remarkable of the planetary nebula. Singularly enough, Dreyer in his careful New General Catalogue does not indicate its planetary character, nor does he indicate anything memorable about it by the usual "! !" His description is

B, S, R, *9M, *8 nf 100″.

So far as its appearance in a great telescope is concerned, it should have the usual planetary nebula sign O, with a string of exclamation points (!) running across the page.

It is a magnificent and beautiful object, a bright star of the ninth magnitude in—not exactly central—a brightish ring which is oval in form and almost incomplete in its southern part. This ring, which is well defined inside and out, is surrounded by a vacuity, and this in turn by an almost circular broad ring of light less intense than the inner ring, and with a distinct break in it north preceding. This ring breaks up into a clouded or unequal surface, and is very irregular on its inner edge but fairly uniformly circular on its outside edge. The inner ring is filled with a nebulous light which has a black spot in it, s p, the nucleus. I have found another excessively difficult star inside the inner ring south of the bright star: this minute star comes to a focus with the nebula and not with the central star. It is therefore doubtless a minute condensation of the nebula not so far advanced in stellar condition as the bright star.

I have measured all the dimensions of this nebula and am making a drawing of it.

No. 1535 is an exact duplicate of 2392, except that its central star is not so bright, and there is lacking the vacuity outside the inner ring, which is also oval in form, with a nebulous interior. Some of the other planetary nebulæ are very wonderful objects, and I am making a special study of them and hope to secure drawings and measures of the more prominent ones.

Several other of the planetary nebulæ now visible were examined for focus, among them Σ 5 (No. 6210) and Σ 6 (No. 6572), nothing could be made out of these except that they were almost identical in form and size and general appearance. The planetary nebula No. 6781 (1860·0 $19^h\ 11^m\ 38^s$, +6° 17′) is annular, the centre being dark. The star measured by Mr. Burnham (*Pub. L. O.*, vol. ii. p. 165), which he speaks of as being north of the middle, is evidently not the nucleus—it looks

more like a star. There is, however, a much fainter star at the middle which looks like the true nucleus, and is of the $16\frac{1}{2}$ mag.

It is intended ultimately to compare all the comparison stars used for focus with some star whose spectrum is definitely known.

Yerkes Observatory, Williams Bay, Wisconsin:
1899 *October.*

Note.—While visiting Potsdam on 1900 February 2, I was shown an excellent photograph of M 57, taken by Dr. Scheiner with the 13-inch photographic refractor, 1894 October 29, at sidereal $21^h\ 20^m$, with an exposure of two hours. This photograph quite clearly shows the nucleus of the nebula; and, upon learning of the discrepancy in the visual measures, Dr. Scheiner very kindly measured the plate for me, and I am happy to be able through his courtesy to give here the results which, though they do not confirm any change in the nebula, are very important as a contribution to the history of the subject.

Through the further courtesy of Dr. Scheiner I was permitted to measure the plate also; but, as I am wholly inexperienced in the measurement of photographs, my measures should have very little weight compared with his, though I shall give the results of the two sets of measures, as supplied me by Dr. Scheiner.

The measures are in rectangular co-ordinates, the distances and position angles having been deduced from them by Dr. Scheiner. "Corrections for refraction and aberration have not been applied. The uncertainty by the reduction to arc may be $\pm 0''\cdot05$, and by the error of the parallel $\pm 0°\cdot15$."

Following are the measures of this photograph referred to Star *a* :—

	S	B	Mean.
	"	"	
Co-ord. in A.R.	60·84	60·54	
Co-ord. in Decl.	0·99	1·32	
Distance (computed)... ...	60·85	60·56	60″·71
Pos. Ang. (computed) ...	89° 4′	88° 45′	88° 55′

The mean results, as shown, are position angle, 88°·92; distance, 60″·71.

It is still important that the nebula be carefully measured with some of our powerful telescopes six or eight years hence.

I wish to express my great obligations to Dr. Scheiner for his kindness.

London:
1900 *February* 10.

The Exterior Nebulosities of the Pleiades, with a Drawing from the different Photographs; and on the appearance of the involved Nebulosities of the Cluster with the 40-inch Refractor. By E. E. Barnard.

In *Astronomische Nachrichten* 3253, Bd. 136, I have given an account, with a rough chart, of what I have called the exterior nebulosities of the *Pleiades*, and which were shown on photographs made with the Willard 6-inch portrait lens in 1893 December. In that paper I have stated: "For many years, during my comet-seeking, I have known of a vast and extensive, but very diffused, nebulosity north of the *Pleiades*. Other masses of this diffused matter make their presence known by a general dulling of the field when sweeping in the neighbourhood of the cluster. . . . It has been my hope during the past two or three years to sometime be able to secure a photographic impression of these vague nebulosities that I had seen in the telescope. It was evident this would require a long exposure. The mounting of our Willard lens does not permit an exposure to be carried beyond the meridian; to get sufficient time would therefore require more than one night. This past winter I have been able, by carefully inclosing the camera box in thick black cloth and by taking other precautions, to extend the exposure through two nights with success. Previous to this I gave an exposure on the *Pleiades* of four hours, which showed all the well-known nebulosities and gave faint suggestions of more distant wisps of nebulæ."

Circumstances prevented my securing a long-exposure photograph of the *Pleiades* in the winter of 1894, and since then I have not had an instrument for the purpose.

As in the case of the great nebula of ρ *Ophiuchi*, these nebulosities were known to me visually for many years before they were photographed. Indeed, there are other such nebulous regions elsewhere which I have seen in comet seeking, and I hope soon to be able to secure photographs of them, as in the case of the *Pleiades* and of ρ *Ophiuchi*. Some of these yet unphotographed nebulosities are, I believe, fully as remarkable as those just mentioned.

In the winter of 1898 Dr. H. C. Wilson, of Northfield, Minnesota, fully verified the exterior nebulosities of the *Pleiades*, and secured good photographs of them. In an endeavour to verify them he had secured traces as far back as 1894, with an exposure of $11^h\ 15^m$; but the photographs of 1898, with $5^h\ 35^m$ exposure, showed them distinctly. Dr. Wilson has given an account of these photographs, with reproductions, in *Popular Astronomy* for 1899 February.

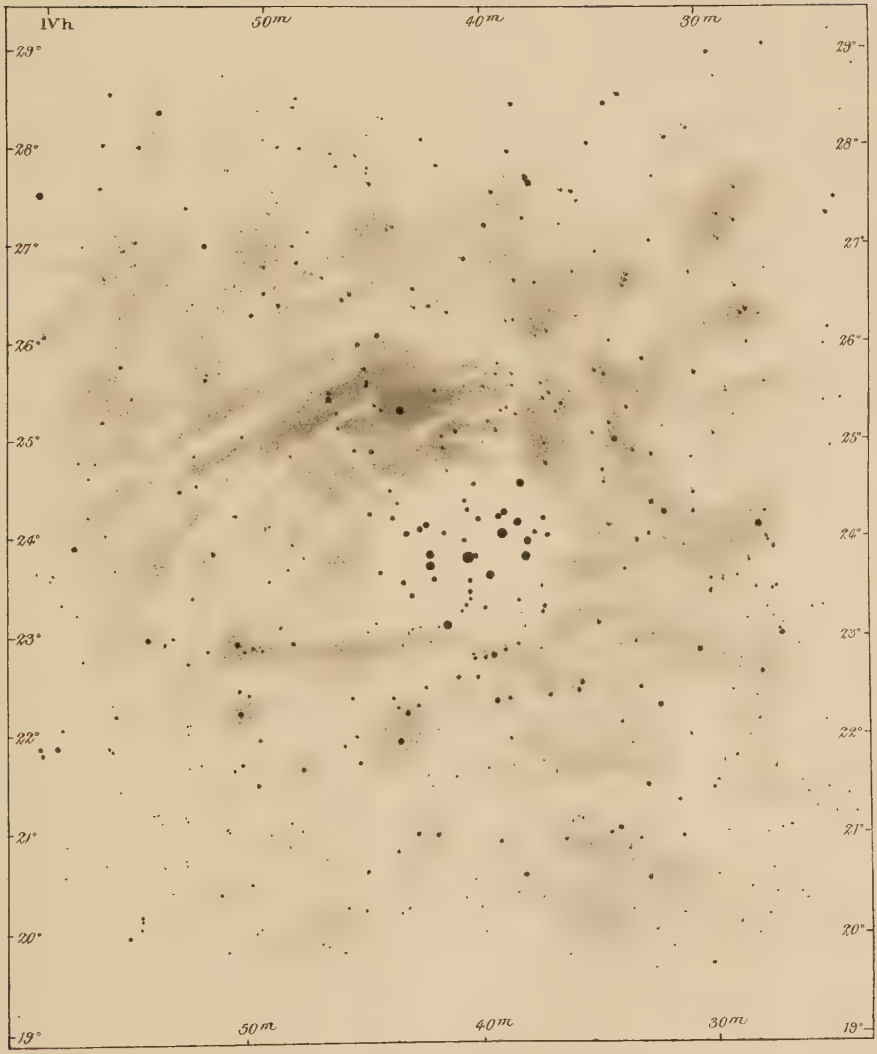
In the summer of 1898, while visiting Harvard College Observatory, I was shown, among many other interesting photographs, one of the *Pleiades* made at Arequipa, Peru, on 1897 October 29, by Professor Bailey with the 8-inch Bache telescope.

PHOTOGRAPH OF THE REGION OF THE PLEIADES,

SHOWING THE EXTERIOR NEBULOSITIES.

Made at the Arequipa, Peru, station of the Harvard College Observatory, with the 8-inch telescope, 1897 October 29. Exposure 300 minutes.

The fainter nebulosities have been brought out by successive intensifications from an original positive.



EXTERIOR NEBULOSITIES OF THE PLEIADES.

DRAWN BY E. CALVERT, FROM PHOTOGRAPHS

The exposure was 300 minutes. On this negative I could easily trace out these exterior nebulosities, though they were faint. Through the kindness of Professor E. C. Pickering I have been supplied with a glass positive of this picture, with permission to publish it (Plate 9).

This photograph readily verifies those made by me in 1893 and by Dr. Wilson in 1894 and 1898. Every detail has been perfectly and satisfactorily verified, leaving no question, in the mind of an unprejudiced person, of the existence of those singular nebulosities exterior to, but connected with, the *Pleiades.**

One startling fact brought out by the study of these photographs is that the *Pleiades* and their involved nebulosities are but the central condensation of an enormous nebula, intricate in details, and covering at least 100 square degrees of the sky.

The great magnitude of this nebula or nebulosity appears almost beyond belief. Taken, however, in the light of other masses of nebulosity revealed by photography, such as those in *Monoceros*, in *Cygnus*, and in *Ophiuchus*, not to mention the great curved nebula stretching across a large portion of the constellation of *Orion*, it should not appear at all strange. Indeed, however strange it may appear is of little consequence, for it is an established fact that must be faced and accepted.

During the present summer I have taken advantage of a visit of Mr. E. Calvert, my brother-in-law, a skilled artist, to get him to make a careful drawing of these nebulosities from the various photographs, basing the work on the Harvard College photograph on account of its greater scale. The result is a very beautiful and accurate drawing in negative. This drawing I have forwarded with this paper, after having placed a system of coordinates around it by which the position of any feature of the nebula may be taken at sight for the epoch 1900 (Plate 10).

The drawing does not show the full extent of the nebulosities, and is therefore only a partial map of these remarkable features. The nebulosities extend for a considerable distance in all directions beyond what is shown on the drawing, which terminates rather abruptly. Especially does the nebulosity extend to the eastward much further than shown. The portion drawn covers from about $\alpha = 3^h\ 25^m$ to $\alpha = 4^h\ 0^m$, and from $\delta = +19°$ to $\delta = +29°$, extending thus over some ten degrees square.

It was not thought desirable to draw in the older nebulosities, as they are already so well known, and were burned out on the prints from which the drawing was made. The bright stars of the cluster, however, are shown for convenience in the study of the picture, and are inclosed in a faint circle inside of which all the previously known nebulosities are located.

The remarkable peculiarities of the nebula are strikingly shown in the drawing. It will be seen that the brightest portion

* On a recent visit to Dr. Max Wolf I was shown an excellent negative of the *Pleiades* in which the exterior nebulosities are distinctly traced. [Note added Feb. 1900].

(which ought to be easily photographed by such an instrument as the Crossley reflector at the Lick Observatory) is the centre of strongly marked details in

$$\alpha = 3^h\ 44^m\ \delta = +25^\circ{\cdot}4.$$

This is at the 6^m star Piazzi iii. 170, which is Rad. 434, and whose position for 1860·0 is

$$\alpha = 3^h\ 41^m\ 54^s{\cdot}30\ \delta = +25^\circ\ 9'\ 15''{\cdot}3.$$

There is some delicate detail of a wispy nature in

$$\alpha = 3^h\ 34^m \text{ from } \delta = +21^\circ{\cdot}5 \text{ to } \delta = +24^\circ{\cdot}0.$$

Many of the details shown on this drawing will be fairly easy objects to photograph with the larger reflectors, whose scale will be big enough to show their individual peculiarities. Indeed, from what is already shown with the portrait lenses, I believe many of these details are far more interesting and peculiar than any involved in the cluster itself.

While on the subject of the *Pleiades*, I have lately, while measuring stars in the cluster, examined the inner nebulosities, and have been struck with their distinctness in the great telescope. The nebulosities in the region of *Merope* are perhaps the most striking. The following edge of the nebula of *Merope* which follows *Merope* some 5′, and which on the Henry Brothers chart extends from $3^h\ 39^m{\cdot}7$ to $3^h\ 40^m$, and from $\delta = +23^\circ\ 35'$ to $+23^\circ\ 40'$, is remarkably sharply defined, so much so under the best conditions that one could easily lay a micrometer wire along it to a second of arc. There are several long strips of nebulosity between this and *Merope*, which are very conspicuous objects. Even the original nebulosity discovered by Tempel, extending south-westerly from *Merope*, and which is specially suited for small telescopes, comes out very strong in the 40-inch. The small roundish nebula close to *Merope* which was found with the 36-inch in 1890, is a decidedly conspicuous object. Under the best conditions it seems somewhat irregular in outline.* The nebulosities about *Maia* are very easy, and strongly shown. The prong-like projection preceding from *Electra* is well seen, but rather faint and diffused. Some of the nebulosities about *Alcyone* could be made out, but this region is difficult from the radiance of *Alcyone* and its neighbouring stars.

I have now 120 nights' measures of the difference of declination of *Atlas* and *Pleione* for the study of temperature changes in the 40-inch object glass, and this work has frequently led me to examine the *Pleiades* and their involved nebulosities.

In conclusion, with reference to the photographs of the exterior nebulosities of the *Pleiades* made in 1893, I would refer to a previous paper of mine in *Monthly Notices*, vol. lvii. pp. 10–16, in which a photograph is reproduced in negative. For a com-

* With the 40-inch there is an excessively faint point of light on the edge of the nebulosity towards *Merope*.

parison of this with our present drawing, it must be looked at in a mirror, or must be supposed to be seen through the back of the paper, since it is reversed, or in the same condition with reference to orientation as the original negative looked at from the film side. The title of the above paper is "On the Comparison of Reflector and Portrait Lens Photographs."

That photograph has suffered in the reproduction, and does not show the exterior nebulosities as distinctly as it ought to.

On the photographs of the *Pleiades* made in 1893 December a star near *o Persei* is shown to be densely involved in nebulosity. It is 7′ south of, and 3′ following, *o Persei*, and is identified as DM +31°·643. The position for 1855·0 is

$$\alpha = 3^h\ 35^m\ 27^s{\cdot}6 \quad \delta = +31^\circ\ 42'{\cdot}2.$$

It is given as $8^m{\cdot}2$ in DM.

I have lately examined this star (which is reddish in colour) with the 40-inch, and it is surrounded for some distance with conspicuous nebulosity.

Yerkes Observatory, Williams Bay, Wisconsin:
1899 *November.*

On the Diameter of Ceres and Vesta. By E. E. Barnard.

During the oppositions of 1894 and 1895 a series of measures of the diameters of *Ceres* (1), *Pallas* (2), *Juno* (3), and *Vesta* (4), were made with the 36-inch of the Lick Observatory (*M.N.* vol. lvi. pp. 55–63).

The diameters thus obtained were (reduced to Δ 2·7673) :—

Ceres	... ...	0″·389	23 nights
Pallas	... ...	0·244	5 ,,
Juno	... ...	0·095 ±	4 ,,
Vesta	... ...	0·195	18 ,,

I have endeavoured to redetermine these diameters here with the large telescope, but the conditions have not been favourable for the use of sufficiently high power for the purpose. A few nights' measures, however, were obtained of *Ceres* and *Vesta*. These, though not considered so satisfactory as the measures which I secured in 1894 and 1895, verify the diameters then obtained, and show that they can be relied upon as being as accurate as can be secured by the work of one observer.

The following are the only measures it has been possible to secure with the 40-inch.

Ceres (1).

	Apparent.	Δ 2·7673.
	″	″
1897 Nov. 22	0·64	0·42
„ 23	0·55	0·36
Dec. 26	0·57	0·34
„ 27	0·55	0·33
1898 Jan. 2	0·51	0·31
		0·352

Vesta (4).

	Apparent.	Δ 2·7673.
	″	″
1899 Sept. 26	0·38	0·21
Oct. 7	0·32	0·17
„ 8	0·26	0·14
		0·175

The observations were difficult in each case.

These values when combined with the previous measures will not sensibly change them, and the first series should have the greatest weight. If we make this combination, weighting, by number of observations alone, we should have: Diameter of *Ceres*, 0″·383; diameter of *Vesta*, 0″·192, at distance 2·7673.

Yerkes Observatory, Williams Bay, Wisconsin:
1899 *October* 26.

Observations of the Leonids, 1899. By C. Michie Smith, Director of the Kodaikanal and Madras Observatories.

A careful watch for *Leonids* was carried out from the Kodaikanal Observatory on the morning of November 14 and on the three following nights. The approximate position of the Observatory is Lat. 10° 14′ N., Long. 5^h 10^m E.; height above sea level 7,700 feet. The following observations were made by the director and the first assistant, Mr. K. V. Sivarama Aiyar. Observations were also made by others of the assistants, but it has not been considered necessary to give these, as they do not cover any extra time. The time used is Madras mean time.

Date.	Count begins.	Count ends.	No. of Leonids seen.	Remarks.
	h m	h m		
Nov. 13	15 52	16 07	2	
	16 10	16 25	nil	
	16 25	17 10	3	1 equal to Venus.

Date.	Count begins. h m	Count ends. h m	No. of Leonids seen.	Remarks.
Nov. 14	13 20	14 00	4	
	14 00	15 00	4	
	15 00	16 00	4	15 of these were of the first magnitude.
	16 00	16 30	6	
	16 30	17 05	7	
	Watch ended at $17^h\ 15^m$ in advancing dawn.			
15	12 10	13 00	4	
	13 00	14 00	3	
	14 00	15 00	7	21 of the first magnitude.
	15 00	16 00	7	
	16 00	17 00	15	
	17 00	17 09	9	
16	12 00	14 00	1	
	14 00	15 00	Not observed	
	15 00	16 00	6	
	16 00	17 00	3	

The weather throughout was fine, with only very light passing clouds or occasional thin films of mist driving over the Observatory.

All records in this and the following lists were made within the area of Professor Pickering's map.

At Madras, Professor R. Ll. Jones, assisted by S. Solomon Pillai and S. Sitarama Aiyar, observed in nearly equally favourable weather, with the following results :—

Date.	Count begins. h m	Count ends. h m	No. of Leonids seen.	Remarks.
Nov. 13	10 00	15 00	nil	Fine and clear.
	15 00	16 00	3	
	16 00	17 00	5	
14	12 00	13 00	nil	Quite clear after $13^h\ 30^m$.
	13 00	14 00	1	
	14 00	15 00	nil	
	15 00	16 00	10	Moon set $15^h\ 45^m$.
	16 00	17 00	16	
	17 00	17 13	1	

Date.	Count begins. h m	Count ends. h m	No. of Leonids seen.	Remarks.
Nov. 15	12 20	14 15	nil	Passing clouds.
	14 15	15 00	3	
	15 00	16 00	8	Moon set about $16^h\ 35^m$.
	16 00	17 00	12	
16	—	15 08	nil	
	15 08	16 00	3	
	16 00	17 00	1	
17	15 00	17 00	2	Cloudy till 15^h.

Of the other counts that have been forwarded to me, the most interesting is a series made by the Rev. Oswald O. Williams, B.Sc. (London), L.S.A., at the Mission House, Karimganj, Assam. This station is thirty-four miles due east of Sylhet, and the time used was local mean time, which is 49^m fast of Madras mean time. The following is a summary of the results :—

Date.	Count begins. h m	Count ends. h m	No. of Leonids seen.	Remarks.
Nov. 13	13 30	14 00	2	Clear sky.
	14 00	15 00	nil	
	15 00	16 00	12	
	16 00	16 30	8	
	16 30	16 45	4	Zodiacal light magnificent.
	16 45	17 00	4	
14	13 30	—	1	Sky perfectly clear.
	After Moon set.			
	16 00	16 15	11	
	16 15	16 35	Several seen but not counted.	
	16 35	16 45	12	
	16 45	17 00	24	2 of first magnitude.
	17 00	17 08	12	
	17 08	17 15	10	
		Dawn.		
	17 15	17 18	4	
	17 18	17 22	5	
	17 33	17 30	2	
15	Very foggy. No observations.			
16	Went out thrice but saw no meteors, much moonlight.			

Kodaikanal Observatory.

Note on the Unpublished Observations made at the Radcliffe Observatory, Oxford, between the years 1774 *and* 1838 ; *with some Results for the year* 1774. By Arthur A. Rambaut, M.A., D.Sc., Radcliffe Observer.

The debt which Astronomy owes to the enlightened liberality of the University of Oxford and to the zeal of its two illustrious Professors, Hornsby and Robertson, who devoted a large proportion of their lives to the editing of the remarkable series of observations made by Bradley at the Royal Observatory, Greenwich, is well known to all lovers of Astronomy of precision.

At the Radcliffe Observatory were compiled, and at the University Press were printed, the two large tomes entitled *Astronomical Observations made at the Royal Observatory, Greenwich, from the year* 1750 *to the year* 1762—the first volume edited by Hornsby, in 1798, the second by his successor, Robertson, in 1805.

On this foundation was built up the superb structure of Bessel's *Fundamenta Astronomiæ*, and, at a much later date, the valuable system of star places which we owe to Auwers' *Neue Reduction der Bradley'schen Beobachtungen.*

In the opening paragraph of his preface to the *Fundamenta* Bessel pays a just tribute of admiration to the diligence and industry of these remarkable men, and all who have ever had occasion to make use of Bradley's observations will endorse Bessel's words. But while the names of Hornsby and Robertson must ever be associated with that of Bradley in this work, many astronomers are, I think, unaware that the admiration which these two eminent men felt for their illustrious predecessor—for Bradley, too, had been Professor of Astronomy at Oxford—was not confined to a minute and careful study of his work, but was exhibited in a still more practical form by carrying on and enormously extending his observations with the instruments which the liberality of the Trustees of Dr. Radcliffe's will had placed at their disposal.

When the Radcliffe Observatory was built (1771–1773), it was equipped with instruments by Bird similar, but in some important respects superior, to those which he had previously made for Bradley at Greenwich. These consisted of two quadrants of 8-feet radius, a transit instrument of the same focal length, and a zenith sector of 12 feet.

With these instruments Hornsby and his successors, Robertson and Rigaud, maintained a systematic and regular series of observations for 65 years, from 1774 to 1838, interrupted only, owing to Hornsby's failing health, between the years 1803 and 1810, when he died. These observations were all regularly and methodically copied into large folio books, in a form exactly similar to Hornsby's and Robertson's printed edition of Bradley's obser-

vations; but while the results of their zealous labour in editing the latter have become the ground-work of accurate astronomy, their own observations, amounting to the number of about 130,000 transits and more than 60,000 zenith distances, have been allowed to sink into oblivion.

Of the importance attached to his observations by Hornsby himself, and of the high opinion he held of the excellence of his instruments, there can be no doubt from the various statements in his published and MS. writings. More than half a century after their erection Rigaud writes that the quadrant finished in 1772 was probably the finest that the maker ever executed.

With the present staff of the Radcliffe Observatory fully occupied, as they are, with their other astronomical and meteorological duties, I could not hope to reduce and publish this enormous mass of valuable observations which have been lying idle on our library shelves. I have, however, reduced all the observations of stars and the Sun made in the year 1774 as an example of the material that is available, although indeed it is hardly a fair specimen of the whole, since 1774 was the first year of Hornsby's work, when the instruments were still unfamiliar, and some precautions afterwards adopted had not yet been thought of. The reduction of the observations of this year had, however, been commenced by my predecessor, and it was only as the work advanced that the defects of this year's observations, as compared with those of later years, became apparent.

The results have, however, convinced me that these observations are of a very high degree of accuracy, as may be judged from the specimens published in this paper; and I trust that when the facts are made known, means will be found for reducing and rendering available for practical purposes the rich mines of astronomical wealth which have remained so long unworked.

The Transit Instrument.

The transit instrument, with which the following observations were made, continued in use at the Observatory till the year 1842, when it was remodelled by Simms.

In this process, although the instrument had been in use for sixty-nine years, several of the principal parts of it were found so good that they were retained in the new construction.

An account of this instrument is given by Manuel Johnson in the first volume of the Radcliffe Observations. The object glass was a particularly good achromatic, made by Peter Dollond; its focal length was 8 feet and its diameter 4 inches, the whole of which was always employed except for observations of the Sun and of the adjusting mark. The tube of the telescope was composed of four cylindrical pieces attached to a cubical centre-piece. The horizontal axis was 3 feet 10 inches long. The pivots were 1·6 inches in diameter and 2·5 inches

long, of which 0·6 inch only rested on the Y's ; the remaining portion was left for receiving the index of the setting-circle and the rods for connecting the axis with the counterpoises. The counterpoising apparatus consisted of upright bars of iron 18 inches long, cased in mahogany, firmly fixed to the tops of the piers, terminating at their upper ends in knife edges, which formed the fulcra of wooden beams, from one extremity of which hung the counterpoises, and from the other, flat rods of wood with triangular bearings at the bottom to receive the pivots. The inclination of the axis was adjusted by means of a spirit level, and the collimation and azimuth by means of a mark fixed on the north wall of Worcester College at a distance of about 682 yards to the south of the transit instrument. Whenever the line of collimation appeared to Dr. Hornsby to be sensibly in error, he seems to have adjusted it to zero ; and in a similar way the error of inclination was eliminated by the use of the spirit level.

Dr. Hornsby's minute watchfulness as to the adjustments of his transit instrument is shown by a number of entries in his journal both for 1774 and later years. Thus under the date 1778 July 29 he says : "Immediately before the observation of *Arcturus* I examined the Instrument by the Level and found the Eastern End of the Axis too high by 3″. The alteration of the Instrument has generally been this way, and I attribute it to the weight of the Center part of the Observatory, which, though at the distance of several feet from the western Pier, seems to affect that Pier more than the other, which is about 5 feet further distant. It is very rare to perceive any alteration in the direction of the Instrument or the Line of Collimation."

Here he refers to the central tower, 100 feet high, which was then being erected. On 1779 March 27 he writes : "The Axis of the Instrument was found truly horizontal. Since the Center part of the Building has been finished, and the Ground has received its full weight, the western end of the Axis has ceased to sink."

Dr. Hornsby, too, seems to have been very careful to take precautions against the disturbing effect of the solar heat on the instruments before and during his observations of the Sun. We have, indeed, no explicit statement that he shielded his transit instrument from the Sun's rays, but we have the indirect evidence afforded by notes of exceptions to such a habit. Thus on 1776 January 29 we have a note to the transit of the Sun's first limb : "Did not shade y^e Axis." Also on 1779 March 25 : "N.B. The Sun had shone upon the western end of the Axis, before the meridional obsn. of the Sun this day was made, but the Axis had been shaded near half an hour." Again, on 1779 October 21 he writes : "I suspect that the Sun began to shine upon a small part towards the middle of the west end of the Axis, when Mercury had passed the second wire."

From these notes it is only reasonable to conclude that his usual custom was to protect the instrument against the disturbing

effect of the Sun's direct radiation. In the case of the quadrants, however, we have a note under 1774 May 31 to the effect: "Applied a Strip of Mahogany to the Pier to prevent the Sun from shining on the Quadrant during the time of observation at noon;" in which position it still remains.

The Sidereal Clock.

We have no explicit statement as to the clock which was used by Hornsby for his transit observations, but many considerations lead me to conclude, with a high degree of certainty, that it was no other than the old clock, by John Shelton, which stands to the present day in the old transit-room in the east wing of the Observatory building. This clock is furnished with a gridiron compensating pendulum of brass and steel, with a dead-beat escapement, flint pallets, and maintaining power. It is of beautiful workmanship, and still performs very well. The character of its performance 126 years ago may be judged from the table of clock rates for the year 1774 as given on pp. 271–2.

Mural Quadrants.

The two mural quadrants were made by John Bird, between the years 1771 and 1774, on the lines of the similar instrument constructed for Bradley at Greenwich about twenty-one years previously. These two instruments were in every particular alike in design, and were mounted on the north and south faces of the same pier in the extreme east of the Observatory. In each case the object glass was a Dollond of 3 inches; but the aperture was limited to 2·75 inches by the elliptic reflector placed in front of it for illuminating the field. The radius of each quadrant was 8 feet, and, as was usual in Bird's instruments, the arcs were furnished with two sets of divisions; the inner set to degrees and twelfths of a degree, the outer into the ninety-sixths of a right angle, each ninety-sixth part being again divided into sixteen. Each of these arcs was read by a vernier, which was further subdivided by a micrometer screw attached to the telescope as in Bradley's instrument.

In these, as with other quadrants by Bird, the divisions of the 96 arc seem to be much superior to those of the 90 arc; and for this reason in the observations of 1774, though both arcs were usually read, we have only employed those of the 96 arc.

It is not necessary to give here a detailed description of these instruments, as the description contained in Bird's paper "On the Method of constructing Mural Quadrants," published in 1768 by order of the Commissioners of Longitude, is in every respect applicable to them, and the illustrations of that paper might have been made from the Oxford quadrants. These quadrants

still stand in their original positions at the Radcliffe Observatory, and though certain small alterations have from time to time been made in them—such as an eyepiece micrometer to the south quadrant, which seems to have been supplied by Edward Troughton—they are substantially the same instruments with which Hornsby worked.

The error of the arc of each quadrant was very carefully determined by Hornsby by the method used by Bradley for this purpose, and described on p. 24 of Bird's paper referred to above. From a careful investigation he concludes that the 96 arc of the north quadrant is $13''$ too great, and the 96 arc of the south quadrant $1''{\cdot}5$ too little. Corrections for these errors have been applied to all the observations given below.

Reduction of the Observations.

Right Ascensions.—In reducing the observations of R.A. I have taken Bessel's formula, viz. :—

$$\alpha = t + \tau + m + n \tan \delta + c \sec \delta$$

where α denotes the right ascension, t the clock time of transit corrected for diurnal aberration, and the other symbols have the same signification as in Bessel's *Fundamenta*.

In view of the care which Hornsby devoted to the adjustment of the collimation, and having regard to the stability of the instrument, I have in this preliminary reduction felt myself justified in neglecting the last term, and thus reducing the equation to the form

$$\alpha = t + p + n \tan \delta$$

an expression which very much simplifies the computations.

On three dates, however, when Dr. Hornsby found the exceptional collimation error of $0^{s}{\cdot}08$, we have applied a correction for this error in the usual way before deducing the constants p and n.

For deducing the values of p and n I have limited myself to the transits of the thirty-two stars of Maskelyne's list selected by Professor Newcomb on p. 52 of Appendix III. to the *Washington Observations* for 1870, and the transits of *Polaris* and δ *Ursæ Minoris*. The mean places of these stars for 1774·0 were taken from Newcomb's "Catalogue of 1098 Standard and Zodiacal Stars," their apparent places for the dates of observation being reduced by the aid of "Tabulæ Quantitatum Besselianarum pro annis 1750 ad 1840 computatæ." In deducing the tabular places of *Sirius* and *Procyon* Professor Auwers' corrections for orbital motion have been applied.

The agreement *inter se* of the separate values of p and n affords a very good criterion of the character of the observations

on any day. The following two specimens are selected, not as being particularly good, but because on each date a large number of clock stars were observed. We have on March 16 :—

	n	p
	s	s
α Tauri	−0·320	+25·18
α Aurigæ	·315	25·28
β Orionis	·321	25·18
β Tauri	·314	25·28
α Orionis	·325	25·10
α Canis Majoris	·312	25·32
δ Ursæ Min. S.P.	—	25·24
α Canis Minoris	·316	25·25
β Geminorum	·314	25·28
Means	−0·317	+25·23

and on August 6–7 :—

	s	s
α Tauri	+0·113	+12·01
α Aurigæ	·110	11·90
β Orionis	·109	11·87
β Tauri	·110	11·91
α Orionis	·111	11·96
α Canis Majoris	·113	11·99
α Canis Minoris	·114	12·04
β Geminorum	·111	11·93
α Hydræ	·109	11·88
α Leonis	·117	12·11
β Leonis	·110	11·90
Polaris S.P.	—	11·94
α Virginis	·107	11·82
α Boötis	·107	11·83
α^2 Libræ	·111	11·94
α Coronæ	·106	11·79
α Serpentis	·109	11·89
α Scorpii	+0·115	+12·04
Means	+0·111	+11·93

and in general the agreement is so good as to justify a high degree of confidence in the precision of the observations.

It should be remarked that the value of n in the first example is exceptionally large. The largest value during the year was $0^s·331$. In general it was kept very much smaller.

The following table of the clock rate for each date of observation throughout the year shows very clearly the excellent character of Hornsby's clock :—

Daily Rates of the Sidereal Clock at the Radcliffe Observatory, Oxford, in the Year 1774.

Day.	Daily Rate. s	Day.	Daily Rate. s	Day.	Daily Rate. s	Day.	Daily Rate. s
Jan. 23	+0·21	Mar. 24	+0·76	May 22	+0·60	Aug. 2	+0·95
24	+0·27	25	+0·76	23	+0·60	3	+0·96
25	+0·38	26	+0·67	27	+0·71	4	+0·95
26	+0·55	27	+0·60	29	+0·71	5	+0·93
28	+0·30	28	+0·58	June 1	+0·71	6	+0·90
29	+0·50	29	+0·58	2	+0·71	7	+0·92
30	+0·71	30	+0·58	4	+0·79	8	+0·94
31	+0·60	31	+0·61	7	+0·82	9	+0·94
Feb. 2	+0·66	Apr. 1	+0·57	13	+0·78	10	+0·90
5	+0·60	3	+0·57	16	+0·74	11	+0·94
7	+0·63	4	+0·59	18	+0·62	12	+0·94
8	+0·67	5	+0·64	19	+0·64	13	+0·90
15	+0·67	6	+0·54	26	+0·77	14	+0·95
16	+0·67	7–8	+0·58	28	+0·75	Pendulum adjusted	
17	+0·69	9	+0·62	July 3	+0·85	15	−0·05
18	+0·67	10	+0·63	4	+0·81	17	0·00
20	+0·66	12	+0·72	9	+0·73	18	+0·16
21	+0·53	13	+0·72	11	+0·80	19	+0·05
22	+0·48	18	+0·70	14	+0·84	20	+0·05
23	+0·53	20	+0·56	15	+0·84	21	+0·13
24	+0·56	21	+0·63	16	+0·87	23	+0·25
25	+0·59	23	+0·88	17	+0·90	24	+0·25
26	+0·60	26	+0·70	20	+0·75	25	+0·25
27	+0·63	27	+0·75	21	+0·75	26	+0·18
28	+0·67	May 1	+0·75	22	+0·75	27	+0·05
Mar. 1	+0·69	3	+0·64	23	+0·79	29	0·00
11	+0·65	5	+0·67	24	+0·73	New clock weight	
13	+0·63	8	+0·76	25	+0·64	Sept. 4	−0·05
14	+0·62	9	+0·76	26	+0·69	5	−0·05
15	+0·64	10	+0·73	27	+0·74	7	+0·10
16	+0·63	13	+0·81	28	+0·72	8	+0·21
18	+0·53	14	+0·77	30	+0·80	9	+0·18
19	+0·52	15	+0·66	31	+0·88	10	+0·23
20	+0·59	16	+0·72	Aug. 1	+0·89	11	+0·23

Day.	Daily Rate. s	Day.	Daily Rate. s	Day.	Daily Rate. s	Day.	Daily Rate. s
Sept. 12	+0·06	Oct. 8	+0·20	Nov. 1	0·00	Nov. 29	−0·17
13	+0·07	9	+0·20	9	−0·16	30	−0·06
15	+0·12	10	+0·18	10	−0·13	Dec. 1	−0·03
16	+0·10	12	+0·24	13	−0·05	5	−0·12
19	0 00	14	+0·20	15	+0·14	6	−0·03
20	−0·02	15	+0·14	16	+0·09	7	+0·02
21	−0·06	16	+0·14	17	+0·16	8	+0·05
27	−0·06	20	+0·21	18	+0·18	9	0·00
29	−0·01	21	+0·17	19	+0·19	11	−0·05
30	+0·05	24	+0·06	20	+0·30	13	+0·09
Oct. 1	+0·08	25	+0·13	21	+0·26	15	+0·10
2	+0·15	26	+0·21	23	+0·22	22	+0·01
3	+0·25	27	+0·27	24	+0·08	24	+0·07
4	+0·28	28	+0·30	26	0·00	25	+0·14
5	+0·23	29	+0·27	27	−0·07	30	+0·02
6	+0·23	31	+0·26	Barom. fell 0·75 in.		31	0·00
7	+0·23	Pallets oiled		28	−0·28		

Dr. Hornsby seems to have made a point of observing the Sun and planets on every possible occasion. The care which he took to shield his instrument from the effect of the Sun's heat during the observation has doubtless contributed largely to the remarkable consistency of the results for the Sun as exhibited in the following table :—

Observed Horizontal and Vertical Diameters, and R.A. and Decl. of the Sun, 1774, compared with Tabular Quantities.

Day, 1774.	Duration of Transit of Diameter. Tabular *minus* Observed. s	Number of Wires. Limb I.	Limb II.	Vertical Diameter. Tabular *minus* Observed. ″	R.A. Tabular *minus* Observed. s	Decl. Tabular *minus* Observed. ″
Jan. 23	−0·11	2	3	−4·57	+0·10	+2·25
25	−0·05	3	3	−2·94	+0·25	−0·14
30	+0·03	2	4	−5·80	+0·10	+5·54
31	−0·11	3	3	−3·82	+0·21	+1·75
Feb. 7	0·00	2	2	−3·05	+0·20	+5·59
18	+0·01	1	2	...	0·00	...
20	−0·22	1	2	−5·16	+0·23	+0·84
26	...	...	...	...	−0·07	−0·32
27	−0·38	3	2	−4·45	+0·20	−1·43
Mar. 1	−0·14	2	1	−9·02(::)	+0·25	−1·20

Day, 1774.		Duration of Transit of Diameter. Tabular *minus* Observed.	Number of Wires. Limb I.	Limb II.	Vertical Diameter. Tabular *minus* Observed.	R.A. Tabular *minus* Observed.	Decl. Tabular *minus* Observed.
		s			″	s	″
Mar.	12	−0·36	1	3	−5·08(⋮)	+0·09	+0·33
	13	−0·32	3	3	−2·20	0·00	−0·09
	14	−0·64	1	3	−4·54	+0·16	−1·30
	15	+0·03	3	3	−1·72	+0·16	+2·57
	17	−0·12	2	3	+1·77(⋮)	−0·13	+1·03
	18	+0·06	3	3	−1·50	+0·10	−0·93
	25	−0·40	1	2	+1·74	+0·35	−3·36
	26	−0·09	1	2	...	−0·04	+2·80
	27	−0·12	2	3	+0·59	+0·04	−1·47
	28	−0·17	2	4	−2·01	+0·02	+0·86
	29	−0·06	3	3	−2·86	+0·07	+4·54
	30	−0·04	3	3	−1·24	+0·36	+2·35
	31	−0·16	3	3	−3·58	+0·01	−2·79
Apr.	1	−0·29	2	3	−2·50	+0·18	+2·03
	10	+0·22	3	2	−5·22	+0·17	+3·16
	12	+0·01	1	4	...	(−0·02)	+2·38
	13	−0·14	2	3	−0·26	+0·20	+1·73
	21	+0·25	1	3	−0·81	+0·36	−2·55
	24	+0·16	1	1	...	+0·22	−2·84
	26	−0·01	1	2	−0·26(⋮)	+0·27	+2·52
May	1	−0·12	2	4	...	+0·11	+1·94
	14	+0·16	3	2	...	+0·29	+1·70
	15	+0·04	4	3	...	+0·05	+0·13
	16	−0·12	4	4	...	+0·14	−0·24
	18	...	...	...	...	...	+0·78
	27	...	...	...	...	...	−0·12
June	1	−0·01	2	1	...	−0·02	+0·24
	2	+0·26	1	4	...	+0·07	−4·23
	4	+0·04	4	4	...	+0·12	−2·28
	7	−0·18	1	2	...	+0·01	+0·36
	11	...	...	...	...	(+0·29)	−0·50
	12	+0·10	2	4	...	+0·26	+0·61
	13	−0·23	4	3	...	−0·01	+0·03
	16	−0·15	1	3	...	+0·02	−1·70
	18	+0·04	3	2	...	+0·09	+4·09

Apr. 12, June 11. Clock-errors doubtful.

Day, 1774.		Duration of Transit of Diameter. Tabular *minus* Observed.	Number of Wires. Limb I.	Limb II.	Vertical Diameter. Tabular *minus* Observed.	R.A. Tabular *minus* Observed.	Decl. Tabular *minus* Observed.
		s			"	s	"
June	19	+0·07	3	3	...	+0·06	−0·01
	29	−0·05	2	3	...	+0·33	+0·70
	30	−0·10	1	3	...	(+0·33)	−3·07
July	4	−0·18	3	3	...	+0·09	−0·36
	8	+0·13	4	4	...	+0·13	−0·87
	9	0·00	4	3	...	+0·10	+0·61
	11	+0·06	4	2	...	+0·07	−0·22
	16	+0·03	2	3	...	+0·33	+4·15
	23	−0·14	3	4	...	+0·25	...
	24	−0·01	4	4	...	+0·16	...
	25	...	...	...	...	+0·14	+2·97
	26	+0·15	4	4	...	+0·29	+5·03
	28	−0·19	4	4	...	+0·22	+1·88
	30	+0·09	1	4	...	0·00	+1·86
Aug.	1	+0·04	2	3	...	+0·11	−0·45
	2	−0·20	4	3	...	+0·24	−4·25
	3	−0·45	3	3	...	+0·13	+3·25
	5	−0·22	4	4	...	+0·32	+1·13
	7	0·12	4	4	...	+0·09	−1·55
	8	−0·02	3	4	...	+0·12	−1·90
	9	0·00	2	2	...	+0·16	+2·67
	10	−0·11	3	4	...	+0·01	+1·16
	11	+0·04	2	4	...	+0·19	−3·37
	12	+0·14	4	2	...	+0·02	+0·27
	15	−0·05	2	2	...	+0·07	...
	18	−0·08	2	3	−4·03	+0·14	+0·49
	19	+0·06	2	3	...	−0·21	+2·05
	21	−0·06	3	3	...	+0·09	−2·07
	22	+0·18	2	3	...	−0·09	−5·04
	23	...	...	...	...	+0·10	−0·18
	24	+0·03	2	3	−0·92	+0·48	+1·57
	25	+0·13	3	3	−2·29	+0·09	−1·63
	26	−0·09	3	3	...	+0·10	−3·79
	29	−0·17	2	3	−6·28	+0·26	−1·90
Sept.	3	−0·16	4	4	...	0·00	−2·92

June 30. Clock-error doubtful.

Day, 1774.		Duration of Transit of Diameter. Tabular *minus* Observed.	Number of Wires. Limb I.	Limb II.	Vertical Diameter. Tabular *minus* Observed.	R.A. Tabular *minus* Observed.	Decl. Tabular *minus* Observed.
		s			"	s	"
Sept.	5	...	...	...	...	+0·23	−1·87
	7	−0·02	3	2	...	−0·03	+0·81
	8	−0·18	3	2	−8·36	+0·01	−0·97
	9	−0·12	3	1(⋮)	−7·06	0·00	−4·46
	11	−0·42	1	3	−5·92	+0·22	−0·62
	13	−0·09	3	4	...	+0·22	−0·74
	14	+0·18	2	2	...	+0·07	−3·59
	15	−0·10	3	3	−3·74	+0·03	−3·00
	16	+0·19	3	3	−1·94	−0·10	−3·71
	23	+0·10	3	3	−4·47	(−0·14)	−0·20
	27	−0·21	2	3	−4·97	−0·03	+2·58
Oct.	2	...	...	...	...	+0·18	...
	3	+0·10	3	3	−2·22(⋮)	+0·11	−0·53
	4	−0·09	3	3	−5·11	+0·06	−0·90
	5	+0·14	2	2	−4·66	+0·27	+0·31
	6	+0·20	3	3	...	−0·04	...
	8	+0·07	3	3	−9·03	+0·30	+0·28
	9	0·00	3	1	...	+0·12	−3·78
	10	...	...	...	...	(+0·07)	−3·83
	11	+0·26	3	3	...	+0·20	+2·24
	12	−0·03	3	3	−3·90	+0·25	−1·61
	15	+0·09	3	3	−4·92	+0·03	−1·92
	16	−0·07	3	3	−6·19	+0·14	−0·15
	20	−0·12	2	3	−5·64	−0·05	−4·03
	24	−0·09	4	5	...	+0·02	−2·23
	25	−0·11	4	5	...	+0·11	−3·39
	26	−0·02	3	3	−4·75	−0·12	−3·79
	27	−0·03	3	3	−5·91	−0·04	−1·00
	28	−0·20	2	2	...	+0·11	−1·00
Nov.	10	−0·07	4	5	...	−0·02	−3·67
	12	...	...	...	...	+0·35	...
	13	−0·05	2	4	...	+0·14	−2·28
	16	...	...	...	...	+0·23	+2·55
	18	−0·06	3	3	−3·45	0·00	−1·70
	19	−0·10	3	3	−4·90	+0·02	−1·50

Sept. 23. Clock-error doubtful.

Day, 1774.		Duration of Transit of Diameter. Tabular *minus* Observed.	Number of Wires. Limb I.	Limb II.	Vertical Diameter. Tabular *minus* Observed.	R.A. Tabular *minus* Observed.	Decl. Tabular *minus* Observed.
		s			″	s	″
Nov.	20	+0·14	3	4	+0·02	+0·01	−1·21
	24	−0·20	3	3	−0·31	+0·14	−2·84
	29	+0·19	3	3	+2·48	+0·04	−2·08
	30	−0·06	3	3	−4·91	+0·16	−3·21
Dec.	1	−0·16	3	3	−5·36	+0·17	−4·08
	7	−0·20	3	4	−6·55	+0·16	−4·26
	13	+0·15	2	3	−2·85	+0·05	−0·88
	15	−0·40	1	3	−1·41	+0·14	−0·70
	22	−0·09	3	3	−8·14	+0·13	−1·82
	24	+0·10	2	4	...	+0·10	−2·68
Mean Errors for the Year		−0·042	...	...	−3·68	+0·118	−0·43

The times occupied by the transits of the Sun's diameter, and its vertical diameter, and the R.A. and Decl. of the Sun have been compared with the values of the same quantities as deduced from Newcomb's Tables. In computing the former the mean horizontal parallax of the Sun has been taken as 8″·80, and for its mean semi-diameter Professor Auwers' value of 16′ 1″·18 has been adopted. The values of the semi-diameter used to reduce observations of only one limb have been formed as explained in the *Radcliffe Observations*, 1890–91, p. xv, reading Newcomb's Tables for *Nautical Almanac*.

The general agreement throughout the year of the tabular and observed right ascensions of the Sun's centre is, I think, very remarkable, the mean difference for the year—when a few observations are neglected for which the clock-error was doubtful, or which were marked as unsatisfactory by Dr. Hornsby—being only 0ˢ·118. The symbols which Dr. Hornsby adopted for denoting various degrees of dissatisfaction, consisting of from two to six dots enclosed in brackets, are reproduced in the above table.

Declinations.—In determining the error of the line of collimation of the south quadrant I have relied on the declinations of the same list of thirty-two stars as was used for the clock-error. As was customary in his time, Dr. Hornsby frequently adjusted his instrument with great care by means of the screw provided for that purpose, so that the plumb-line should bisect two minute dots, one near the centre, and one near the zero of the graduations (cf. Bird's Paper). To determine the error of the line of collimation, therefore, we have to compare the declination, or zenith distance, of the standard stars, as observed

with the quadrant, with their computed values, and the mean of the differences so obtained is the "error of the line of collimation."

No complete investigation of the effect of temperature on either of the quadrants has yet been made. In the case of the north quadrant, the observations of the year 1774 are too few for a satisfactory examination of the question; and any such examination must be postponed till the observations of subsequent years are available for discussion. For the south quadrant, however, I have plotted down as ordinates the separate results in declination for a number of stars which were frequently observed, the abscissæ representing the temperatures; but I have been unable in any case to recognise a relation between the two, and am convinced that the effect of temperature, if it is sensible at all, must be very slight indeed.

The refractions have been computed as in the Radcliffe volumes for recent years. In the calculation of the refraction, we have taken Hornsby's readings of the internal and external thermometers without correction, but the barometer has been affected by a correction of $-0{\cdot}037$ inch, as adopted by the late Mr. Stone from a memorandum found among Dr. Hornsby's papers. Dr. Hornsby seems to have been particularly careful in reading his barometer and thermometers.

The Probable Error of the Results.

In the *Fundamenta Astronomiæ* Bessel computes the mean error in R.A. and Decl. of Bradley's observations. From 300 observations of the stars *α Tauri*, *α Canis Majoris*, *α Canis Minoris*, *α Boötis*, and *α Aquilæ*, he finds the mean error of a single observation to be $\pm 1''{\cdot}45$; and from 300 observations of *α Canis Majoris* and *α*, *β*, and *γ Aquilæ*, he finds as the mean error of an observation in right ascension $\pm 0^s{\cdot}2114$. With a view to instituting as direct a comparison as possible between Hornsby's and Bradley's observations, with regard to their freedom from accidental errors, I have computed the mean error from such observations of the same groups of stars as Hornsby obtained in the year 1774. In the first group we have 158 observations of the declinations of the six stars composing it, and the mean error computed, as in Bessel's *Fundamenta*, is $\pm 1''{\cdot}87$. This seems to show that Dr. Hornsby's observations of declination in the year 1774 were not so good as Bradley's were. The difference, however, is on the whole not so marked as this mean error would seem to indicate, for this larger value is to a great extent due to irregularities in the observations of *Sirius*. The observations of some of the other stars of this group are considerably above Bradley's average of consistency. Thus the mean error computed from the thirty-three observations of *Arcturus* amounts to only $\pm 0''{\cdot}80$. The probable error of an

observation in declination computed in the usual way from the 158 observations of these six stars is $\pm 1''\cdot 27$. In right ascension Hornsby's observations for this year, as judged by their mean error, are considerably more trustworthy than those of Bradley. From 114 observations of the four stars selected by Bessel we find the mean error of an observation in right ascension to be $\pm 0^s\cdot 0798$, or, if all are reduced to the equator by the factor $\cos\delta$, $\pm 0^s\cdot 0785$; while the probable error of a single observation in right ascension amounts to only $\pm 0^s\cdot 053$. The observations of the Sun are also of a high order of accuracy. In computing the probable errors of the observed R.A. and Decl. of the Sun I have compared the observed places with the places computed from Newcomb's Tables. The differences are given on pp. 272 to 276. The mean difference for the year as given at the end of the table is taken as a constant systematic correction to the tables, and being subtracted from each individual difference gives the residuals from which the probable errors are computed. In this way I find the probable error of an observation of the Sun's R.A. is equal to $\pm 0^s\cdot 0834$, while in declination I find the probable error $\pm 1''\cdot 62$.

Conclusion.

In order to form an approximate idea of the number of observations contained in the unpublished journals in the period (1774–1838) I have had the number of folio pages counted for each year, and the actual number of observations counted for the years 1774, 1775, 1776, 1785, 1791, 1800, 1814, 1825, and 1836, as shown in the accompanying Tables A and B. It should be remarked that in Table A the numbers of observations of the Sun, Moon, and planets, which are given in separate columns, are included in those contained in the second and third columns.

Table A.

Numbers of Observations in Several Years.

Year.	Counted Number of Transits.	Counted Number of Zen. Dist.	Sun.		Moon.	
			T.	Z.D.	T.	Z.D.
1774	3138	1160	134	125	30	31
1775	3064	1439	156	160	41	39
1776	2554	1020	147	117	37	38
1785	1890	676	144	122	25	25
1791	3690	638	183	142	28	26
1800	1941	200	134	96	22	24
1814	2166	1506	150	142	74	73
1825	1687	1654	168	163	58	56
1836	1987	1294	141	136	48	47

Year.	Mercury. T.	Z.D.	Venus. T.	Z.D.	Mars. T.	Z.D.	Jupiter. T.	Z.D.	Saturn. T.	Z.D.	Uranus. T.	Z.D.
1774	19	20	41	42	22	20	20	18	24	23	...	...
1775	39	35	53	48	45	42	36	34	23	20	...	...
1776	32	29	46	42	18	17	40	43	15	14	...	...
1785	15	11	27	26	19	19	22	22	7	5	13	11
1791	34	26	57	54	16	13	41	38	17	16	2	2
1800	3	1	13	12	8	7	16	18	3	2	6	6
1814	...	...	7	7	5	5	30	30	9	10	...	...
1825	...	...	...	...	...	...	3	3	8	8	...	...
1836	...	...	...	...	...	...	7	4	8	3	...	...

TABLE B.

Numbers of Folio Pages of the Journals.

Year.	Folios of Transits.	Folios of Z.D's.	Year.	Folios of Transits.	Folios of Z.D's.	Year.	Folios of Transits.	Folios of Z.D's.
1774	58	24	1794	53	$8\frac{1}{2}$	1820	25	25
1775	57	28	1795	75	13	1821	28	27
1776	50	20	1796	53	8	1822	31	29
1777	41	14	1797	55	7	1823	24	22
1778	57	16	1798	53	7	1824	25	23
1779	99	$24\frac{1}{2}$	1799	39	4	1825	29	28
1780	68	$16\frac{1}{2}$	1800	33	$3\frac{1}{2}$	1826	$25\frac{1}{2}$	24
1781	62	15	1801	28	7	1827	36	26
1782	29	$13\frac{1}{2}$	1802	30	5	1828	30	29
1783	48	$18\frac{1}{2}$	1803	15	2	1829	25	21
1784	25	$13\frac{1}{2}$	1804–10	No records		1830	33	29
1785	30	$14\frac{1}{2}$	1811	45	13	1831	30	21
1786	36	16	1812	42	$26\frac{1}{4}$	1832	31	25
1787	40	16	1813	47	$20\frac{1}{2}$	1833	38	25
1788	48	23	1814	38	$27\frac{1}{2}$	1834	33	27
1789	43	19	1815	39	35	1835	$32\frac{1}{2}$	22
1790	55	18	1816	33	33	1836	32	21
1791	$76\frac{1}{2}$	21	1817	43	43	1837	31	19
1792	58	10	1818	30	30	1838	8	3
1793	56	$10\frac{1}{2}$	1819	39	39			

From these tables it may be estimated that in the period 1774 to 1803 there are about 78,000 transits and 20,000 zenith distances observed, while in the period from 1811 to 1838 there are about 53,000 transits and 41,000 zenith distances. These numbers include the observations of the Sun, Moon, and major planets. It will thus be seen that these bodies have received a

large share of attention, and the reduction and publication of these observations alone would be of enormous value for improving the tables of their movements. I estimate that in the whole period there are more than 8,000 observations of the Sun, a number but little less than that on which Le Verrier's tables were founded, and covering the period when the corrections to the mean longitude of the Sun as deduced from the observations of Greenwich, Paris, and Koenigsberg are most discordant. Thus, we have here an enormous mass of observations of the Sun, Moon, and planets completely independent of Greenwich with regard to personal and instrumental errors, the importance of which for correcting the tables can scarcely be called in question.

Dr. Hornsby's working list seems to include all Flamsteed's stars, and most, if not all, of Bradley's. A list which has come down to us includes 4870 stars, some as faint as the ninth magnitude ; but at present I am unable to say how many of these have been actually observed. During the year 1774, and in some of the later years which I have examined, it would seem that attention was chiefly concentrated on a comparatively short list of moderately bright stars, the fainter stars not being so frequently observed. In the year 1774 there have been 2948 observations of the R.A. of 446 stars, and 881 observations of the declination of 136 stars.

Of the star observations the most valuable portion will probably prove to be those previous to 1820. In all questions of proper motions the importance of these observations, filling up, as they do, the long gap between Bradley and Piazzi, or Bradley and Pond, is at once obvious ; nor can we say that we have availed ourselves of all possible material for the determination of the constant of precession, and of the Sun's motion in space, until these observations have been fully reduced and discussed.

It may be asked, If Hornsby held a very high opinion of his own observations, why did he not himself give them to the world, instead of devoting so many years of his life to editing Bradley's journals ? But it is probable that Hornsby meant his work to be a continuation and extension of that done by Bradley ; and when Bradley's observations were, in 1776, presented to the University of Oxford by Lord North, and by the University entrusted to him as editor, he naturally looked upon the publication of Bradley's observations as the first step in a great piece of work, in which the second step would be the publication of his own.

The specimens contained in this paper will, however, enable astronomers to form some estimate for themselves of the value of Dr. Hornsby's observations. The present resources of the Radcliffe Observatory are unfortunately not large enough to encourage us to hope that we could reduce and publish the whole mass of observations without neglecting for a number of years equally, or perhaps even more, important branches of investigation. I have, however, felt it to be my duty to examine into

the quality of these observations and to draw up this brief account of what Dr. Hornsby's journals contain, so as to inform astronomers of the wealth of observations which are here available, and I bring it before the Royal Astronomical Society in the hope that its publication may eventually lead to the reduction and publication of the whole.

Mean R.A. and Decl. of a few of the Stars observed at the Radcliffe Observatory, Oxford, in the year 1774.

Day.	Mean R.A. 1774·0.	Mean Decl. 1774·0.
	Polaris.	
	$0^h\ 47^m$ s	+88° 5′ ″
Jan. 23	...	52·02
26	...	52·02
28	...	51·31
29	...	50·85
31	...	52·80
Feb. 2	...	52·47
5	...	53·66
8	...	53·51
20	...	53·70
Mar. 27	9·33	...
29	...	58·89
31	...	56·86
Apr. 1	...	56·00
25	...	57·38
30	8·86	56·36
May 8	...	58·29
9	...	53·11
13	8·34	54·92
15	...	55·48
June 6	9·10	53·23
July 22	10·37	...
27	...	50·40
Oct. 15	7·35	...
20	8·66	...
24	8·42	...
Nov. 13	7·29	...
20	8·72	55·93
28	10·79	54·63
29	8·52	54·69
Dec. 1	9·65	55·50
5	...	55·92
6	8·43	55·78
7	...	56·55
9	...	52·70
30	9·84	54·32
	8·91	54·46
	Polaris S.P.	
	$0^h\ 47^m$ s	+88° 5′ ″
Apr. 20	...	55·35
26	...	52·90
May 1	8·89	51·97
8	...	52·75
9	...	52·89
10	...	53·20
13	8·46	53·59
14	8·24	...
23	...	56·03
27	...	55·54

Polaris: April 30 and July 22. Fluttered.

The weight is determined from a consideration of the number of standard stars used in computing the clock-error and the number of wires at which the transit was observed. It applies, therefore, only to the R.A.

Day.		Mean R.A. 1774·0.	Mean Decl. 1774·0.
		Polaris S.P.—cont.	
		$0^h\ 47^m$ s	+33° 5′ ″
June	2	...	56·33
	7	9·09	55·12
	18	...	55·55
July	22	10·36	...
	24	...	55·08
Aug.	7	...	55·23
	9	...	53·45
Oct.	3	...	54·10
	4	...	53·71
	11	...	54·16
	15	7·35	...
	19	8·64	53·54
	23	8·40	53·46
	24	8·48	54·86
Nov.	12	7·32	55·14
	18	...	52·58
	19	7·73	56·81
	20	9·69	...
	22	...	52·92
	28	10·81	57·47
	29	8·54	55·29
	30	9·64	55·64
Dec.	6	8·45	54·02
	24	...	55·17
	30	9·88	56·33
		8·82	54 52
		α Arietis.	
		$1^h\ 54^m$ s	+22° 23′ ″
Jan.	23	28·66	...
	30	28·86	...
	31	...	6·18
Feb.	2	...	10·05
	5	28·87*	9·65

Day.		Mean R.A. 1774·0.	Mean Decl. 1774·0.
		α Arietis—cont.	
		$1^h\ 54^m$ s	+22° 23′ ″
Feb.	8	28·64	11·22
	18	...	8·95
Mar.	13	28·71	...
	14	28·69	...
	15	28·68	...
	28	28·85	...
	31	28·67	...
May	15	28·47	...
June	12	28·64	...
	17	28·47	...
July	22	28·50	2·72
Nov.	13	28·54	...
		28·65	8·13
		δ Arietis.	
		$2^h\ 58^m$ s	+18° 51′ ″
Jan.	26	44·38	...
	28	44·50*	...
Feb.	5	44·78	32·72
	8	44·60*	29·33
		44·57	31·03
		η Tauri.	
		$3^h\ 34^m$ s	+23° 23′ ″
Jan.	27	5·49*	...
	28	5·47†	...
	29	5·40*	25·53
	30	5·52	...
	31	5·32	...
Feb.	5	5·15	29·58
	6	5·25	29·11
	8	5·27*	...
	16	5·34	29·00
	20	...	26·36

α Arietis : February 2. Windy, and plumb-line unsteady.

* Half weight given to these observations.
† Quarter weight given to these observations.

Day.	Mean R.A. 1774·0.	Mean Decl. 1774·0.
	η Tauri—cont.	
	$3^h\ 34^m$ s	+23° 23′ ″
Feb. 21	5·42	...
24	...	26·92
Mar. 13	5·38	25·83
29	5·12	...
31	5·11*	...
July 22	5·19*	...
23	5·32	...
Dec. 6	5·35	...
	5·32	27·48
	Aldebaran.	
	$4^h\ 22^m$ s	+16° 2′ ″
Jan. 23	58·49*	11·21
24	...	12·95
26	58·46	...
29	...	12·46
31	...	11·39
Feb. 28	58·40*	...
Mar. 13	58·69	12·68
16	58·52	11·43
27	58·40	13·17
29	58·45	...
30	58·53	11·65
31	58·52	11·41
Apr. 1	58·54	11·79
10	58·57	10·74
21	...	13·12
May 1	58·36	7·38
15	58·60	...
June 17	58·58	...
July 22	58·53	15·43
23	58·40	10·48
24	58·53	9·00
25	58·35	8·87
26	58·45	...

Day.	Mean R.A. 1774·0.	Mean Decl. 1774·0.
	Aldebaran—cont.	
	$4^h\ 22^m$ s	+16° 2′ ″
July 29	58·57	...
30	58·52	7·94
31	58·57	...
Aug. 1	58·68*	15·75
2	58·41	14·04
6	58·39	11·94
9	58·53	...
10	58·53	...
11	58·45	11 29
17	58·49	13·32
19	58·39	11·56
20	58·48	...
22	58·40	...
	58·49	11 71
	Capella.	
	$5^h\ 0^m$ s	+45° 44′ ″
Jan. 26	1·84*	...
Feb. 5	1·62*	...
24	...	34·81
26	1·87	...
Mar. 13	1·63*	...
14	1·53	...
16	1·59	37·38
27	1·62	...
28	1·54	...
29	1·74	...
31	1·78	...
Apr. 1	1·66	...
10	1·65	...
13	1·74	37·53
May 1	1·63	...
15	1·58	...
June 12	1·62	...
17	1·59	...

Aldebaran: July 25 and 30. Air undulated much.

* Half weight given to these observations.

Day.	Mean R.A. 1774·0.	Mean Decl. 1774·0.
	Capella—cont.	
	$5^h\ 0^m$ s	+45° 44′ "
July 22	1·80	...
23	1·70	37·25
25	1·62	...
26	1·63	...
27	1·75	...
29	1·67	38·38
30	1·60	35·62
31	1·55	41·18
Aug. 1	1·51	38·00
2	1·53	37·79
6	1·68	...
10	1·88	...
11	1·76	...
12	1·84	...
16	1·72	...
17	1·79	...
19	1·74	...
20	1·69	...
22	1·60	...
28	1·49	...
Sept. 4	1·53*	...
7	1·80	...
8	1·90	...
	1·73	37·55
	Capella S.P.	
	$5^h\ 0^m$ s	+45° 44′ "
July 23	1·01†	35·55
Aug. 10	...	39·69
21	1·44	33·62
	1·35	36·29
	β Tauri.	
	$5^h\ 12^m$ s	+28° 23′ "
Feb. 5	1·21*	...
Mar. 13	1·18	...
16	1·23	...

Day.	Mean R.A. 1774·0.	Mean Decl. 1774·0.
	β Tauri—cont.	
	$5^h\ 12^m$ s	+28° 23′ "
Mar. 27	1·29	...
30	1·19	...
31	1·34	...
Apl. 1	1·36	...
10	1·23	...
13	1·38*	...
27	...	41·99
May 1	1·16	...
16	1·28	...
June 12	1·34	...
17	1·15	...
July 22	1·36	...
23	1·30	...
24	1·37*	...
26	1·34	...
30	1·22	...
31	1·07	...
Aug. 1	1·17	...
2	1·27	...
6	1·30	45·37
10	1·26	...
11	1·35	46·87
12	1·37	45·04
16	1·35	...
17	1·39	...
19	1·20	...
22	1·17	45·07
24	...	43·25
26	1·20	...
28	1·20	43·46
Sept. 4	1·33	...
7	1·13	...
8	1·19	...
	1·26	44·44

Capella: July 25. Air undulated much. September 8. Air unsteady.
β Tauri: September 8. Air unsteady.

* Half weight given to these obs. † Quarter weight given to these obs.

Day.	Mean R.A. 1774·0.	Mean Decl. 1774·0.
	μ Geminorum.	
	$6^h\ 9^m$ s	$+22°\ 36'$ "
Feb. 20	17·12	37·72
21	17·22	39·44
Mar. 31	...	31·83
Apr. 1	17·30	33·50
Sept. 19	17·14	37·07
Oct. 2	17·35	38·65
3	...	33·52
4	17·28	33·67
7	17·21	35·45
	17·23	35·65
	Sirius.	
	$6^h\ 35^m$ s	$-16°\ 25'$ "
Feb. 26	11·25	...
28	11·00	...
Mar. 1	11·08	...
13	11·11	...
14	11·28*	...
16	11·12	...
24	11·21	...
27	11·22	...
28	11·19	17·88
30	11·22	17·80
31	11·16	17·54
Apr. 1	11·17	16·77
13	11·14	15·80
May 1	11·18	18·40
15	11·21	18·26
June 18	11·36	...
July 23	11·25	...
24	11·14	19·73
25	11·31*	...
31	11·19*	...
Aug. 1	11·21	15·91
2	11·24	20·10

Day.	Mean R.A. 1774·0.	Mean Decl. 1774·0.
	Sirius—cont.	
	$6^h\ 35^m$ s	$-16°\ 25'$ "
Aug. 6	11·15	15·85
11	11·10	14·06
12	10·98	16·37
16	11·22	16·81
17	11·16	17·55
19	11·14	19·68
20	11·21	...
22	11·35	19·10
23	11·37	...
26	11·31	...
28	11·31	18·38
Sept. 4	11·41	18·04
7	11·30	18·11
8	11·04	12·83
9	11·19	17·07
11	11·18	16·78
15	11·29	16·20
18	11·22	15·19
19	11·22	14·44
28	...	11·83
Oct. 1	...	15·69
2	11·09	13·45
3	11·03	16·62
4	11·19	17·06
7	11·35	...
	11·20	16·43
	Castor.	
	$7^h\ 20^m$ s	$+32°\ 21'$ "
Feb. 17	8·78*	...
25	8·67*	...
28	8·55*	...
Mar. 11	8·67	...
13	8·85*	...
16	8·85	...

Sirius: July 24. Fluttered much. August 1. Air undulated.

* Half weight given to these observations.

Day.	Mean R.A. 1774·0.	Mean Decl. 1774·0.
	Castor—cont.	
	$7^h\ 20^m$ s	+32° 21′ ″
Mar. 25	8·72	…
26	8·82*	…
27	8·60	…
30	8·71	…
Apr. 1	8·46	…
8	8·57*	…
10	8·64*	…
13	8·77*	…
May 1	8·73	44·58
15	8·65	…
June 7	8·65	…
13	8·74	…
July 22	8·68*	…
23	8·80	…
31	8·37*	…
Aug. 1	8·56	…
6	8·46	45·76
11	8·73	…
17	8·64	…
19	8·79	45·41
20	8·71	…
22	8·74	…
Sept. 4	8·63	48·62
7	8·78	…
8	8·86	…
9	8·84	…
10	8·72	…
11	8·69	46·91
15	8·69	46·84
18	8·59	45·98
28	8·71	48·06
Oct. 1	8·80	48·48
2	8·88	…

Day.	Mean R.A. 1774·0.	Mean Decl. 1774·0.
	Castor—cont.	
	$7^h\ 20^m$ s	+32° 21′ ″
Oct. 3	8·92	46·23
4	8·79	47·93
7	8·73	…
9	8·90†	…
10	9·02	…
	8·74	46·80
	Radcliffe (1845), 2218.	
	$8^h\ 24^m$ s	+85° 1′ ″
Oct. 24	19·65*	56·42
25	17·34*	55·73
26	19·14*	55·89
	18·71	56·01
	Radcliffe (1845), 2218 *S. P.*	
	$8^h\ 24^m$ s	+85° 1′ ″
Oct. 25	17·41	56·55
26	…	57·58
		57·07
	Regulus.	
	$9^h\ 56^m$ s	+13° 3′ ″
Mar. 13	18·88	…
24	18·77	…
Apr. 13	18·86	…
26	…	48·17
May 1	18·97*	46·58
8	18·86	50·37
10	18·95	46·55
15	18·94	49·17
June 1	…	50·69
4	…	51·71
July 20	18·89	…
24	18·84	…

Castor: August 1. Air undulated much. August 6. Saw the small star; it preceded about $0^s{\cdot}2$.

* Half weight given to these observations.
† Quarter weight given to these observations.

Day.	Mean R.A. 1774·0.	Mean Decl. 1774·0.
	Regulus—cont.	
	$9^h\ 56^m$ s	+13° 3′ "
July 25	18·87	...
28	18·91	...
Aug. 2	18·81	...
7	18·71	...
10	18·78	...
Sept. 4	18·87	...
7	18·87	...
8	19·00	...
18	18·89	...
Oct. 2	18·88	44·90
3	18·96	48·08
10	...	47·78
15	18·90	...
24	18·84	50·34
25	18·83	46·80
26	18·83	...
Nov. 9	18·81	...
22	...	47·92
	18·87	48·39
	γ Leonis.	
	$10^h\ 7^m$ s	+20° 58′ "
Mar. 24	28·84	...
Apr. 8	28·88†	...
18	28·68*	...
26	28·74*	...
May 1	28·93	37·28
7	28·85	...
8	29·04	38·06
Aug. 7	28·60	...
Sept. 10	29·04	...
14	28·86*	...
18	28·79*	...
19	28·85	...
Oct. 2	29·11	...

Day.	Mean R.A. 1774·0.	Mean Decl. 1774·0.
	γ Leonis—cont.	
	$10^h\ 7^m$ s	+20° 58′ "
Oct. 3	29·06	...
10	29·03	...
11	28·96*	...
15	28·65	...
24	28·98	...
25	28·84	36·65
26	28·86	35·48
28	29·06*	...
Nov. 9	28·77	37·58
22	28·75*	...
	28·89	37·01
	β Virginis.	
	$11^h\ 38^m$ s	+3° 2′ "
Jan. 23	55·35*	18·68
Mar. 13	55·53*	...
26	55·29	...
27	55·56	...
May 1	55·46*	16·11
9	55·34	...
10	55·30	14·58
13	55·20*	16·33
23	55·31	18·70
June 1	55·40	...
18	55·24	...
Nov. 12	55·21	...
18	55·34	...
19	55·53*	...
	55·35	16·88
	12 *Canum Ven.*	
	$12^h\ 45^m$ s	+39° 32′ "
June 7	25·19	...
18	25·33	...
July 15	25·36	...
16	25·34	...

* Half weight given to these observations.
† Quarter weight given to these observations.

Day.	Mean R.A. 1774·0.	Mean Decl. 1774·0.
	Canum Ven.—cont.	
	$12^h\ 45^m$ s	$+39°\ 32'$ "
Aug. 2	25·42	...
7	25·37*	34 08
9	25·48*	...
Oct. 19	25·45*	...
27	25·32	...
Nov. 9	25·38	...
12	25·39	...
17	25·42	...
18	25·44	...
19	25·26	31·68
20	25·33	...
29	25·08	...
30	25·10*	35·69
Dec. 6	25·33*	...
	25·33	33·82
	Spica.	
	$13^h\ 13^m$ s	$-9°\ 58'$ "
May 9	18·74	...
June 18	...	28·09
26	...	29·27
July 15	...	32·26
16	...	33·50
20	18·73	...
24	18·75	34·43
Aug. 5	18·78	32·53
7	18·90	31·13
9	...	30·77
10	18·82	30·52
17	18·56	...
19	...	32·52
20	...	31·96
21	18·82	...
23	18·76	33·58
27	18·92	...

Day.	Mean R.A. 1774·0.	Mean Decl. 1774·0.
	Spica—cont.	
	$13^h\ 13^m$ s	$-9°\ 58'$ "
Oct. 5	18·78	...
19	18·65	...
24	18·74	...
25	18·94	...
26	18·91	...
Nov. 12	...	27·02
18	18·78	29·99
22	...	28·44
28	18·79	28·45
29	18·89	28·58
30	...	28·48
Dec. 12	...	29·60
24	18·65	29·02
	18·78	30·51
	Arcturus.	
	$14^h\ 5^m$ s	$+20°\ 22'$ "
June 26	...	4·95
28	...	1·78
July 14	...	3·86
17	...	2·67
20	21·58	...
24	21·64	...
25	21·63	...
Aug. 2	21·38	3·66
5	21·59	1·94
7	21·65	3·31
20	...	2·84
21	21·51	3·43
23	21·57	2·46
24	21·51	2·87
27	21·54	2·85
29	21·54	...
Sept. 8	21·66	2·87
12	21·59	4·10

* Half weight given to these observations.

Day.	Mean R.A. 1774·0.	Mean Decl. 1774·0.
	Arcturus—cont.	
	$14^h\ 5^m$ s	+20° 22′ ″
Sept. 13	21·49	4·31
Oct. 3	21·61	0·99
5	21·61	2·23
7	21·54	3·53
8	21·61	1·80
9	21·55	…
15	21·52	3·61
16	21·56	2·86
20	21·64	…
25	21·75	…
Nov. 9	21·56	…
12	…	2·20
16	…	3·54
18	21·61	3·29
22	…	3·28
28	21·59	3·60
30	…	4·10
Dec. 8	…	3·54
12	…	3·71
14	…	3·32
21	21·56	4·58
23	21·47	3·36
24	21·24	3·98
	21·56	3·19
	α Coronæ.	
	$15^h\ 25^m$ s	+27° 29′ ″
Aug. 2	7·58	…
5	7·48	14·54
7	7·60	16·91
21	7·54	14·73
24	7·50	13·94
Sept. 13	7·50	…
Oct. 5	7·50	…
15	7·54	…

Day.	Mean R.A. 1774·0.	Mean Decl. 1774·0.
	α Coronæ—cont.	
	$15^h\ 25^m$ s	+27° 29′ ″
Oct. 24	7·47	…
25	7·47	…
Dec. 23	7·52	…
24	7·66	15·90
	7·53	15·20
	Antares.	
	$16^h\ 15^m$ s	−25° 54′ ″
Jan. 24	34·99	…
25	34·95	…
29	34·86*	36·76
July 15	…	41·56
20	35·18	…
Aug. 2	35·19	…
5	35·05	…
7	34·93*	40·90
10	35·05	41·19
21	35·06	40·18
24	35·15	43·29
Sept. 8	35·07	39·65
12	35·06	…
20	35·10	40·07
30	35·09	38·83
Oct. 3	34·94	42·44
5	35·12	39·85
15	35·07	…
Dec. 23	35·00	…
24	35·10	…
	35·06	40·43
	α Herculis.	
	$17^h\ 4^m$ s	+14° 39′ ″
Aug. 21	21·10	…
24	20·97	45·91
Sept. 12	21·01	…

* Half weight given to these observations.

Day.		Mean R.A. 1774·0.	Mean Decl. 1774·0.
		α Herculis—cont.	
		17h 4m s	+14° 39′ ″
Oct.	5	21·17	...
	7	21·19	...
	8	20·96	...
	9	21·02	...
	15	21·11	...
Nov.	10	21 19	...
		21·08	
		α Lyræ.	
		18h 29m s	+38° 35′ ″
Jan.	23	...	2·16
	24	17·45	6·21
	25	17·53	6·04
	29	17·22	6·16
	30	...	5·77
Feb.	4	...	6·74
	15	...	6·81
	19	...	4·69
	26	17·38	6·68
	28	...	6·95
Mar.	12	17·19	5·07
	13	17·30	6·78
	14	17·28	4·10
Aug.	21	17·14	....
Sept.	12	17·29	...
	20	17·39	...
	27	...	6·28
	30	17·31	6·94
Oct.	1	17·18	6·03
	3	17·35	2·11
	5	17·33	4·13
	6	17·35	5·64
	7	17·25	...
	8	17·30	...

Day.		Mean R.A. 1774·0.	Mean Decl. 1774·0.
		α Lyræ—cont.	
		18h 29m s	+38° 35′ ″
Oct.	9	17·40	...
	12	17·39	..
	14	17·39	...
	15	17·46	...
	16	17·30	5·29
	20	17·41	5·06
	21	...	4·29
	25	17·39	3·69
	26	17·39	...
Nov.	13	17·43	...
	19	17·41	5·45
Dec.	22	17·48	7·73
	24	17·37	4·74
		17·35	5·44
		ζ Lyræ.	
		18h 36m s	+37° 22′ ″
Sept.	4	59·49†	...
Oct.	7	59·68	50·98
	8	59·73	50·07
	9	59·69	50·45
	12	59·63	50·40
	14	59·58	...
	15	59·67	...
		59·66	50·47
		δ Ursæ Min.	
		18h 44m s	+86° 32′ ″
Mar.	28	45·47	...
Sept.	27	...	9·09
	30	...	5·87
Oct.	1	45·07	9·89
	5	45·52	7·62

* Half weight given to these observations.
† Quarter weight given to these observations.

Day.		Mean R.A. 1774·0.	Mean Decl. 1774·0.
		δ Ursæ Min.—cont.	
		$18^h\ 44^m$ s	+86° 32′ ″
Oct.	7	46·08	7·50
	8	44 90	10·39
	20	44·88	...
	21	...	8·32
		45·32	8·38
		δ Ursæ Min. S. P.	
		$18^h\ 44^m$ s	+86° 32′ ″
Feb.	16	...	9·58
Mar.	27	45·80	...
	28	45·47	...
Oct.	1	45·08	...
	3	...	6·80
	4	45·51	7·14
	7	45·47	8·76
		45·47	8·07
		θ Lyræ.	
		$19^h\ 8^m$ s	+37° 44′ ″
Sept.	12	31·53	...
	20	31·44	...
	27	31·67	...
	30	31·65	33·90
Oct.	1	31·65	33·46
	3	31·49*	34·11
	5	31·40	33·95
	6	31·49*	34·83
	7	31·62	33·88
	15	31·58	...
		31·56	34·02
		χ Aquilæ.	
		$19^h\ 31^m$ s	+11° 18′ ″
Oct.	1	56·11	...
	3	55·92	32·94
	6	55·92	...

Day.		Mean R.A. 1774·0.	Mean Decl. 1774·0.
		χ Aquilæ—cont.	
		$19^h\ 31^m$ s	+11° 18′ ″
Oct.	8	...	32·84
	9	...	31·61
	14	56·00	...
		55·99	32·46
		α Aquilæ.	
		$19^h\ 39^m$ s	+8° 17′ ″
Jan.	24	45·23	15·00
	25	45·19*	12·90
	29	45·31	11·75
	30	...	12·95
Feb.	6	...	14·06
	7	45·21	12·53
	16	...	13·97
	22	...	12·02
	26	45·15*	14·25
	28	...	15·01
Mar.	12	45·28	14·38
	13	45·27	12·82
	14	45·31	...
	28	45·20	11·26
Sept.	8	45·15	...
	13	45·28	...
	20	45·18	...
	27	...	11·05
	30	45·23	...
Oct.	1	45·26	...
	3	45·22	...
	5	45·28	...
	6	45·23	...
	8	...	14·33
	9	...	12·04
	12	45·02	...
	14	45·24	...
	16	45·28	...
	26	45·20	...

* Half weight given to these observations.

Day.		Mean R.A. 1774·0.	Mean Decl. 1774·0.
		α Aquilæ—cont.	
		$19^h\ 39^m$ s	+8° 17′ ″
Oct.	29	45·25	...
Nov.	13	45·30	...
	16	...	11·42
	26	...	12·24
	27	45·37	...
	30	45·26	11·53
Dec.	9	...	12·90
	11	45·27	11·56
	25	45·29	12·60
		45·24	12·84
		α Cygni.	
		$20^h\ 33^m$ s	+44° 28′ ″
Jan.	23	44·08*	52·75
Feb.	4	43·87	57·26
	26	44·14*	...
Mar.	12	43·87*	...
	13	43·91*	...
	14	43·84	55·42
	28	43·87	...
Apr.	9	...	56·89
	12	...	55·35
Oct.	5	43·85	...
	9	43·88	...
	12	43·95	...
	14	44·03	...
	15	43·85	...
	16	43·99	...
	25	43·93	...
	26	44·09	...
Nov.	24	43·97	...
	27	44·04	54·76
	29	43·93	53·21
	30	43·90	55·44

Day.		Mean R.A. 1774·0.	Mean Decl. 1774·0.
		α Cygni—cont.	
		$20^h\ 33^m$ s	+44° 28′ ″
Dec.	6	44·02	55·86
	9	...	56·21
	11	43·97	55·44
	22	44·04	...
	25	44·20	...
		43·96	55·33
		ε Pegasi.	
		$21^h\ 33^m$ s	+8° 50′ ″
May	3	5·10*	...
Oct.	24	5·38	...
	27	5·36*	...
Nov.	21	5·22	...
	24	5·24	...
	26	5·37	...
	30	5·21	54·96
Dec.	15	5·34	53·69
	25	5·33	52·21
		5·29	53·62
		21 *Piscis Aust.*	
		$22^h\ 38^m$ s	−30° 43′ ″
Oct.	12	50·44	39·40
	14	50·63	38·19
	15	50·31	...
	20	50·41	...
	24	50·48	40·70
Nov.	28	50·50	36·47
	29	50·47	37·26
Dec.	6	50·77*	38·30
	11	...	38·84
		50·48	38·45

* Half weight given to these observations.

Day.		Mean R.A. 1774·0.	Mean Decl. 1774·0.
		Fomalhaut.	
		$22^h\ 45^m$ s	$-30°\ 48'$ "
Sept.	30	6·95	...
Oct.	5	7·04	...
	7	7·14	...
	12	7·07	49·80
	14	6·93	46·65
	15	7·00	...
	20	7·12	...
	24	7·22	47·32
	25	6·95	...
	26	7·09	...
Nov.	24	7·23	50·24
	27	7·01	46·97
	29	6·91	...
	30	7·07	...
Dec.	6	7·26	47·45
	11	7·00	52·67
	22	7·00	47·23
	25	7·01	47·50
	30	...	51·56
		7·06	48·74

Day.		Mean R.A. 1774·0.	Mean Decl. 1774·0.
		Piazzi xxii., 262.	
		$22^h\ 47^m$ s	$-30°\ 40'$ "
Oct.	12	11·48	...
	15	11·46	...
	24	11·41	...
	25	11·44	...
	26	11·57	...
Nov.	20	11·48	...
	24	11·62	...
	27	11·38	...
	28	11·43	3·48
	29	11·40	5·06
	30	11·30	5·88
Dec.	6	11·32	...
		11·44	4·81
		α Androm.	
		$23^h\ 56^m$ s	$+27°\ 50'$ "
Mar.	14	44·71	...
	24	44·82	...
	28	44·60	...
Apr.	30	...	32·68
Nov.	29	44·72	...
Dec.	5	...	32·83
	6	44·65	...
	15	...	31·10
		44·70	32·20

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Printed by SPOTTISWOODE & Co., New-street Square, London; and Published at the Apartments of the Society, March 1900.

UNIVERSITY OF LONDON
- 6 NOV 1952